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Export Earnings Fluctuations and Economic Development:

An Analysis of Compensatory Financing Schemes

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THOMAS MORRISON

AND

LORENZO PEREZ

Agency for International Development
September 1975

*Acknowledgements are due to: Constantine Michalopoulos and Keith Jay of AID who commented on different versions of the paper. We also benefitted from conversations with Sidney Weintraub and Sam Levine of AID and with Robert Ryan, Paul Balabanis and Carl Cundiff of the Department of State on the possible liberalization of the IMF Facility. John Wilson of the Board of Governors of the Federal Reserve System made available to the authors his computer program to use the OECD import tapes which substantially reduced the computer work. Cathy Gleason, Lee White, and Claire Fromme of the AID Computer Center provided excellent programming assistance. Maureen Lewis, Devorah Miller and Julian Heriot provided valuable research assistant support. The views presented in this paper are the personal views of the authors and do not necessarily represent Agency policy.

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I. INTRODUCTION

Developing countries have had a long standing and currently resurgent interest in international action to stabilize and increase commodity export earnings. One of the major emphases of the "New International Economic Order" is on the raw material exports of developing countries. In this context, developing countries have demanded higher prices for their commodity exports as a means of raising their export revenue trends and avoiding frequent export revenue shortfalls. Primary commodities account for almost 80 percent of the total export earnings of developing countries, compared with only 25 percent for developed countries. Nearly half of the developing countries earn more than 50 percent of their export receipts from a single primary commodity, and three-quarters of them earn more than 60 percent from three primary products, making their total export earnings very sensitive to commodity market developments. Some developed countries have recently shown interest in the developing countries' demand for greater stability in their commodity exports as evidenced by the STABEX scheme of the Lome' Convention signed in 1975 wherein the European Community agreed to help stabilize some commodity export earnings of 46 developing countries. In addition, the U.S. has proposed a liberalization of the IMF Compensatory Financing Facility at the Seventh Special Session of the United Nations.

This study will examine the problem of export instability in developing countries and analyze various alternatives of international cooperation that might aid in promoting stabilization. The main

focus is on compensatory financing schemes (CFS) designed to stabilize export earnings, rather than on commodity agreements which are usually designed to influence prices. In this sense the focus of the study is on schemes which stabilize export earnings rather than on proposals to affect long run export trends through higher commodity prices. Section II surveys the evidence regarding export instability in developing countries, its causes and consequences, and briefly examines the interests of consuming nations in stabilization. The section concludes by discussing the relative merits of compensatory financing schemes vis-a-vis other types of commodity agreements for the purposes of stabilizing earnings. Sections III through VII consist of a more complete analysis of compensatory financing schemes. An appraisal of past experiences and a discussion of the objectives of compensatory financing schemes are contained in Section III. Section IV describes alternative operating arrangements for compensatory financing schemes and their implications, such as beneficiary and guarantor countries, the terms of the CFS, and measurement techniques of export earnings fluctuations. Section V estimates the financial costs of various alternative compensatory financing schemes if they had been operating from 1959 to 1972. Section VI discusses the issues involved in institutionalizing a compensatory financing scheme. Section VII discusses the economic incentives of compensatory financing schemes and their economic aid aspects. Finally Section VIII summarizes the main findings of the paper.

II. The Case for Stabilization

A. Evidence of Export Instability

Recent investigations have presented convincing evidence supporting the fact that developing countries experience greater export instability

than developed countries. Erb and Schiavo-Campo showed that, while export instability declined for both groups of countries during the periods 1946-1958 and 1954-1966, it declined far more for the developed than the developing countries.[1] Studies by Mathieson and McKinnon, Naya, Glezakos, and Lawson also support the conclusion that developing countries in general suffer a greater degree of export earnings instability than developed countries.[2] MacBean represents an exception to this conclusion, but the data for his study were generally for an earlier period (1946-1958) than the more recent studies.[3]

Individual commodity data also support the existence of considerable export instability in developing countries. Table I shows fluctuation indices for the price, volume and earnings of selected mineral and agricultural commodities. It is evident that there is a substantial amount of instability associated with these commodity exports. For example, the same instability measure computed for a unit value index for manufactured goods between 1957 and 1971 was only 1.14 per cent.[4] This comparison indicates that export instability is much more likely to be a problem in countries heavily dependent on one or a few raw material commodities, a situation found in many developing countries.

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[1] G. Erb and S. Schiavo-Campo (1970), pp. 575-580.

[2] D. Mathieson and R. McKinnon (1972); S. Naya, C. Glezakos (1973); C. Lawson (1974).

[3] A. MacBean (1966).

[4] This is admittedly a rough comparison since the sample years differ and unit value changes are imperfect measures of price changes. In addition there might be some offsetting price movements of individual manufactured products.

TABLE I

Fluctuation Indices in Selected Commodity Prices, Volume and Earnings

(% Deviations from 5 year moving average)

Commodity	Prices[1]	Volume[2]	Earnings[3]
Copper	13.4	3.2	11.4
Tin	6.2	4.7	8.7
Lead	12.9	2.7	10.6
Zinc	13.2	3.4	15.9
Iron Ore	4.2	6.5	8.0
Manganese Ore	7.7	9.7	12.9
Coffee		4.6	4.4
Santos 4	9.5		
Angolan 2AA	8.7		
Cocoa	16.2	5.9	9.9
Sugar			
World ISA Daily	23.1		
U.S. Preferential	3.5		
Beef	6.7	12.2	9.8
Rice	8.2	6.7	5.2
Vegetable Oils			
Groundnut Oil	8.2	11.0	6.9
Soybean Oil	10.4		
Coconut Oil	8.0	8.4	9.0
Palm Oil	7.1	4.0	8.2
Cotton	4.0	5.7	3.9
Jute	10.5	8.6	10.0
Sisal	13.4	3.7	11.4
Rubber	12.9	3.5	12.4
Timber	6.9	4.4	9.1

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[1] The period covered is 1950-1973 except cotton (1952-1973), rice (1951-1973) and jute (1955-1973).

[2] The period covered is 1950-1972 except copper (1952-1972); tin, lead, zinc, iron ore, manganese ore (1953-1972); timber (1953-1971).

[3] The period covered is 1950-1972.

Source: International Bank for Reconstruction and Development, "Price Forecasts for Major Primary Commodities," June 19, 1974, Commodities and Export Projection Division, Report No. 467.

B. Causes and Effects of Export Instability

The causes of instability in the commodity exports of developing countries are related to market changes in typically inelastic demand and supply situations. Supply shifts can be caused by fluctuating climatic conditions and/or long gestation periods, political disturbances, or changes in production policies of governments and private firms. Demand shifts may take place due to cyclical swings in the industrialized countries, speculation, or policies in importing countries (e.g., stockpiles, quotas, etc.). The cyclical problem has been particularly troublesome in recent years since the industrialized countries have been experiencing the same phase of the cycle simultaneously. Accordingly, commodity price fluctuations appear to have been more severe, especially in the period since 1972.

Most empirical studies have not addressed explicitly the causes of export instability for specific country-commodity cases but rather have focused on cross-country patterns. It has been shown that export instability is negatively related to the size of a country and to the total value of exports, and positively related to the degree of concentration of exports.[5/] These results suggest that many poor countries could have serious problems with export instability since many are small and have few exports.

[5/] Erb and Schiavo-Campo found that export instability is inversely related to GNP across developing countries; Naya showed that export instability is positively associated with the amount of exports to neighboring countries and negatively related to the value of exports; B. Massel, (1970) found that export concentration generally increases export instability.

Export earnings instability has a number of potentially detrimental effects on the economies of developing countries. The major costs are related to the impact of export earnings fluctuations on import capacity and thereby on investment planning. If additional reserves are held to accommodate fluctuations in earnings without reducing imports, the cost takes the form of foregone investment opportunities. Furthermore, when the share of commodity exports in total GNP is large, as it is in many developing countries, fluctuations in export earnings can generate a series of multiplier reactions leading to instability of national income, employment, and government revenue.

Accentuating the above consequences of export instability is the fact that developing countries often face considerable internal pressures not to accumulate reserves in a period of rising exports. The result is frequently that governments use these funds to finance their development efforts, reducing their capacity to meet export earnings shortfalls in subsequent periods.

There have been several empirical efforts to assess the costs of export instability. Although the results have sometimes been conflicting, the preponderance of evidence supports the view that export earnings instability is detrimental to the economies of the developing countries. One exception is the MacBean study which showed no relationship between instability of export receipts and GNP growth across a sample of developing countries.[6/] Maizel's review of MacBean's book

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[6/] MacBean, op. cit.

criticizes several aspects of the statistical analysis, and with reformulated equations using the same data shows a significant relationship between fluctuations in GNP and fluctuations in export earnings for about half of the eleven countries.[7/] Kenen and Voivodas, using more recent data, provided evidence of a negative relationship between export instability and investment in developing countries.[8/] In another study also using more recent data than MacBean, Glezakos found that export instability had a negative effect on the real per capita income growth rate in developing countries.[9/]

C. Interests of the Developed Countries

Stability in commodity markets is a concern not only of developing countries, but also of the developed countries. For example, the United States is a major importer of many primary commodities and is heavily dependent on developing countries for several critical raw materials (e.g., bauxite, manganese, and tin). The United States and other developed countries certainly have an interest in commodity markets stability to the extent that it assures a more reliable supply and more stable prices to their industrial and private consumers. More stable commodity prices would make inventory control easier and less expensive for private firms. Inflationary tendencies created by commodity prices fluctuations, which are possible under conditions of downward price rigidity are also avoided.

7/A. Maizel (1970).

8/P. Kenen and C. Voivodas, "Export Instability and Economic Growth." Kyklos (Vol. XXV, 1972), pp. 791-804.

9/C. Glezakos, op. cit.

Additionally, it is obvious that increased market stability would also benefit developed countries' producers of raw materials.[10/]

D. Compensatory Financing vs. Commodity Agreements

In spite of the above benefits, the U.S. and to a lesser extent, other developed countries have traditionally been wary of commodity arrangements mainly because of a reluctance to have governments directly tamper with the operation of commodity markets. As consumers, these countries have been concerned that the end result of such agreements would be to raise commodity prices above equilibrium levels. This is a reasonable concern when considering commodity agreements which are designed to control prices at negotiated levels. Compensatory financing schemes which compensate for shortfalls in export earnings do not directly influence commodity prices and thereby avoid market intervention which is generally objectionable to most developed countries.

Stabilization of export earnings rather than commodity prices might also be preferable for the interests of the developing countries because commodity agreements may create an efficiency problem. If an agreement keeps prices above the free market long-run trend, it may be more difficult to foster export diversification and eliminate inefficient producers. However, the development of non-traditional exports is affected by a large number of economic policies and factors and it might still be possible for countries enjoying artificially high prices for their primary commodity exports to diversify their export base. For

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10/ In Section VII we discuss further how export earning stability can lead to price stability.

example, Brazil and Colombia to a smaller extent, diversified substantially their export bases during the period of the coffee agreement. The effect of commodity agreements on export diversification, therefore, is subject to debate and represents a desirable area for empirical research, not dealt with in this paper.11/

A more practical advantage of a CFS over commodity agreements is that it is probably easier to set up and implement than a large number of agreements dealing separately with individual commodities and bilateral arrangements. Merely achieving consensus among the participating countries on the objectives of the commodity agreement can be a major obstacle. Consumers generally are only concerned about stabilizing export prices, while producers may wish to stabilize export earnings or to use the commodity agreement to achieve long-term increases in export prices or revenues. Each of these groups may favor a different level of export quotas or buffer stock maintenance under various given circumstances. Moreover, since producing and consuming nations have fundamentally opposite interests with regard to the level of prices, agreements have tended to break down when substantial market pressure has been placed on the negotiated price range.

This study is not intended to be a critique of commodity agreements. A CFS and commodity agreements are not mutually exclusive and indeed, as Meade has suggested, might well be complementary.12/ Lessons

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11/ Developing countries' proposals for commodity markets are more concerned with distribution issues than efficiency issues. They seem to assume that they would increase more their incomes through commodity market arrangements which, although questionable on efficiency grounds, would give them a greater share of the trade benefits.

12/ J.E. Meade, "International Commodity Agreemnts", Lloyds Bank Review (July 1964), pp. 28-42.

learned from past failures of commodity agreements may facilitate more effective agreements in the future. This study concentrates on compensatory financing in order to analyze the feasibility and implications of a more comprehensive multilateral, multi-commodity approach to the export stabilization problem in developing countries.

III. Objectives and Experience of Compensatory Financing Schemes

Compensatory Financing Schemes have typically been proposed to finance short-run export earnings shortfalls of primary producing countries. Such schemes are designed to help countries avoid the undesirable effects of export earnings instability on their economic development efforts as discussed in the previous section.

A number of CFS's have been proposed in the past. Some have been geared to mitigate the adverse effects of changes in the terms of trade and others to compensate for shortfalls in export receipts.[13/] More recently there has been discussion of having a compensatory financing scheme which would compensate for losses in purchasing power of export earnings. Export earnings fluctuations are normally measured after taking into account the trend (e.g., difference from a five-year moving average) so that the long- term market prospects are presumably not affected.

A. Experience with Compensatory Financing Schemes

At the present time there are two compensatory financing schemes in operation. The IMF Compensatory Facility was set up in 1963,

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13/ See Gertrud Lovasy (1965), for a good discussion of the different proposals.

expanded in 1966, and currently is being considered for further liberalization. Under the IMF scheme members may request drawings to offset fluctuations in total export receipts due to developments in commodity markets. Member countries can expect these requests to be met if the Fund is satisfied that: (1) the shortfall is of a short-term character and largely attributable to circumstances beyond the control of the member and (2) the member will cooperate with the Fund in an effort to find appropriate solutions for its balance of payments difficulties. An analysis of the operations of the IMF facility between the periods 1969 and 1973 inclusive shows that only about fifty percent of the estimated shortfalls were compensated by the scheme for the countries which qualified for compensation. The existing requirement that borrowings cannot exceed fifty percent of the borrowing countries' quotas has limited the role of the Facility in compensating for export earnings shortfalls.

The other existing CFS, STABEX, was set up by the European Community countries and associated African, Caribbean and Pacific countries within the Lomé Convention in February, 1975. The EC countries contributed 375 units of account (around U.S. $465 million) for a five year fund to compensate for shortfalls of individual commodity exports to the European Community markets.[14/] The Scheme covers 12 commodities and is hence rather limited in trade coverage for some countries. Compensation to ACP

14/ For a description of the scheme, and for the Lomé Convention in general see The Courier, No. 31-Special Issue - March 1975.

members takes the form of loans (or grants to the least developed countries) if (1) a country's earnings from any of the 12 commodities considered individually would drop below a reference level by more than 7.5 percent (2.5 percent for the least developed) and (2) during the previous year a country's earnings from the export of the product to all destinations represented at least 7.5 percent of its total export earnings from merchandise exports (2.5 percent for the least developed LDCs).

STABEX is one part of the aid agreement negotiated in the Lome Convention. The Convention leaves the doors open for converting these loans into grants if the borrowing countries cannot repay the loan in the five-year repayment period. The IMF Facility does not envision exempting members from repayment of the facility loans. A three year grace period is given on repayment, with full payment made in the fourth and fifth year. If borrowing countries have good surplus years during the first three years the IMF expects them to repay earlier but so far no country has done it.

B. Grant Elements

Compensatory Financing Schemes can be considered to a certain extent as economic aid to beneficiary countries. The grant element is a function of the terms of compensation and approaches zero as the funds are made available at close to commercial rates. A CFS in this respect is quite flexible since several aspects of the schemes can be negotiated such as the existence and level of interest charges, repayment periods, degree of compensation, debt limits, and differential treatment of beneficiary countries according to their levels of economic development.

This last aspect may be particularly important if it appears that the more developed of the recipient countries tend to benefit disproportionately from the scheme.

The fact that a CFS makes funds available to developing countries that otherwise might not be available to them even at market rates in itself constitutes a form of economic aid, although it is difficult to quantify a grant element in this case. In principle, if international capital markets are perfect, funds should be available to developing countries to finance short-run export earnings shortfalls, albeit at relatively high interest rates. Due to limitations of the existing capital market institutions, these funds will probably not be available, and thus their availability constitutes a real benefit to developing countries.

Since one of the purposes of this study is to analyze the cost implications of alternative CFS's, we will explore schemes with various grant elements and with recipients differentiated according to their levels of economic development. The schemes considered in this study are discussed in section IV and compared to STABEX and the IMF facility.

C. Compensation Objectives: Total Export Earnings Shortfalls or Individual Commodity Export Shortfalls

A CFS can be set up to compensate for shortfalls of total merchandise exports as in the case of the IMF facility or to compensate for individual commodity exports shortfalls as in the case of STABEX.[15/] If the

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[15/] For that matter service earnings could be stabilized by a CFS but so far the discussions and implementations of CFS have been restricted to merchandise exports.

objective of the scheme is to offset losses of import capacity, compensation for total export earnings shortfalls is appropriate. In dealing with balance of payments problems, total foreign exchange earnings is the most relevant measure. Even if significant shortfalls in individual commodity exports occur, if these are offset by upward fluctuations in other exports, total foreign exchange earnings are not adversely affected.

In addition, assuming that labor moves easily between industries and sectors, total export earning shortfalls would also be the appropriate target variable if we are concerned with the employment implications of export instability. If export earnings were stable, labor released from an industry suffering a shortfall in sales may be absorbed by a growing industry. Yet, time lags and low labor mobility seem to characterize many developing countries. Consequently, stable total export earnings may still conceal serious employment disruptions in individual commodity industries suffering shortfalls in their sales.

This consideration is a further reason why a CFS designed to stabilize individual commodity export earnings should also be examined. Developing countries will want to discuss individual commodity earnings stability in the context of commodity negotiations, since they view this as a commodity problem more than a financial problem. They are typically concerned with terms of trade trends and the growth of demand for individual commodities regardless of performance in other exports and balance of payments flows.

A scheme which is focused on commodity earnings stabilization may appear to be more responsive to the developing countries demands for action in the commodity field. It should be realized, however, that an individual commodity approach is not necessarily more expensive or more beneficial for all developing countries. It could penalize poor countries with diversified exports if strict rules concerning the eligibility of individual commodities in the scheme are applied according to their importance for overall export earnings. One example of this situation is India which has a well diversified export base.

Whether the objective in a CFS is to compensate for total export earnings shortfalls or individual commodity shortfalls, neither of these alternatives should seriously affect resource allocation decisions. It will still pay producers to make decisions according to their perceived comparative advantage. In the case of total export earnings, there is no incentive to produce one commodity in preference to another which is not due to long-run demand perspectives. In the case of a compensatory scheme covering only some of the most important commodity exports, no specific distortions should be created in terms of inducing increases in the production of some of these important commodities whose market prospects do not warrant such increases. For example, if a commodity experiences a shortfall and then persists in a downward trend, after a few years the prevailing downward trend would dominate the estimates. Even if some shortfalls continue to be recorded, the compensation obtained should not be significant enough to encourage producers to stay in that line of production. However, how the system is set up internally

may make a difference . More will be said in Section V on the methodology of measuring short-term fluctuations and how a scheme can be set up to minimize or eliminate any negative impact on resource allocation incentives.

In summary, we believe that a CFS which stabilizes total export earnings is the preferable scheme since the major problem that a CFS is meant to address is fluctuations of import capacity of developing countries. However, we also analyze individual commodities and commodity basket schemes because developing countries are particularly interested in this kind of scheme. Commodity schemes are also worth examining because they could have a favorable impact on commodity market stability which we discuss in Section VII.

IV. Implementing a Compensatory Financing Scheme

Depending on the objectives of a CFS, there are various alternative operating arrangements. Decisions will have to made regarding beneficiary and guarantor countries, the terms of a CFS and the methods of measuring export earnings fluctuations. This section will describe the economic implications of these alternative operating arrangements leading into Section V which estimates and compares the costs of those alternatives.

A. Beneficiary and Guarantor Countries

Depending on the objectives pursued, there are various alternatives for choosing the beneficiaries of a CFS. Since the objective of the CFS is usually to stabilize export earnings of primary commodity producers, one criterion could be to include only countries heavily dependent on exports of primary commodities. However, this criterion might include as beneficiaries some high-income countries. On the other hand, compensatory financing schemes are often viewed as instruments of assistance to poor countries. From this viewpoint, to include rich countries as beneficiaries would not be appropriate.[16/]

Alternatively, a scheme could also be set up for the purpose of stabilizing earnings of certain primary commodity exports with the choice of commodities made in a way to assist primarily the poorest countries.

In this study, all of the criteria discussed above were included in various ways in choosing potential beneficiaries of the CFS. Only countries whose GNP per capita was less than U.S. $1000 in 1972 were selected as potential beneficiaries.[17/] In addition, since one of the purposes of the cost simulations of alternative compensatory schemes is to analyze the results of schemes similar to STABEX and the IMF, STABEX's minimum criterion for choosing commodities was used in the simulations of individual commodity schemes. Any primary commodity which accounted for at least 7.5 percent of a country's total export earnings was

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16/ The present IMF compensatory financing facility does include rich countries as potential beneficiaries.

17/ There are some exceptions to this rule for political reasons or lack of adequate trade data.

included in the scheme. One exception to this rule was made in the case of India which has a low GNP per capita and a very diversified export structure. Indian exports of iron ore and concentrates, jute fabrics, and manganese ore were included in the scheme even though they did not meet the 7.5% requirements and jute fabrics are not primary commodities. Finally, oil exporters were not included on the grounds that oil earnings have changed significantly due to the cartel actions. The potential beneficiary countries by geographical area are listed in Appendix I. The eligible commodities for each country used in the simulations of individual commodity schemes are listed by the Standard International Trade Classification in Appendix II.

The total export earnings of the fifty-nine beneficiary countries in the CFS simulations accounted for 62 percent of the total export earnings of non-oil exporting developing countries.[18/]

A study of compensatory financing schemes should also address the issue of possible guarantor countries and the implications of different possibilities. STABEX is essentially a bilateral arrangement between the European community and the forty-six developing countries of the ACP group. The International Monetary Fund facility is multilateral since its use is not tied to particular market destinations and there is a wide "donor" base. This raises the issue whether the existence of "bilateral" compensatory financing schemes might not create trade

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18/ International Financial Statistics, May 1975, pp. 41-42.

distortions in international trade in the sense that producers might prefer to sell in one market over another for reasons that go beyond market conditions.19/

It seems likely that even if guarantor countries do not ask for specific access to supply guarantees, as in STABEX, it would be in the interest of beneficiary countries to maintain export flows to the guarantors' markets. If an export shortfall takes place due to supply and demand conditions outside the control of the producing countries, they would get compensated for these shortfalls. One should not, however, overemphasize this point since compensatory financing schemes are set up strictly to compensate for short-run fluctuations and hence producer countries should still choose their market destinations based on long-run demand prospects.

At the same time the existence of a bilateral guarantee for an earning flow in a certain market destination might be an incentive for producers to shift their export shipments to other markets and not worry about having shortfalls in the guaranteed markets. This problem can be eliminated by introducing discretionary elements into the scheme, e.g., by examining observed shortfalls to make sure that they are not a result of a policy action of the country suffering the shortfall. Both the IMF scheme and the STABEX Scheme, in fact, have the requirement that an examination has to be made before financing of a shortfall takes place.

19/ This potential distortion depends on whether producers are directly compensated and also whether there are supply constraints.

If the main objective of the scheme is to help developing countries solve their export instability problem, a global multilateral scheme seems to be the most efficient way of accomplishing this objective. It would also eliminate the possibility of some developing countries following export policies which stress short-run prospects and concentrating on fluctuation problems to the current market destinations without worrying about developing new markets with better long-run demand prospects.

Producing countries might have varied fluctuation experiences in their export sales to different market destinations which offset each other. In these instances, a multilateral scheme which includes the most important market destinations for the producing countries would give a more realistic view of the export earning fluctuations of producing countries.

This study has two sets of cost estimates: one having as the donor countries the members of the OECD and the other having the United States as the only donor country. From the point of view of the U.S. Government, the two sets of estimates give some indication of the relative costs for the United States of participating in these schemes.[20/] In discussing the results of the two simulations, alternative burden sharing formulas can be considered to estimate what would have been the guarantor countries' contributions to the financing fund for the period of the study and their share if a scheme is implemented.

20/ It would be interesting to determine the benefits to regions which have special trade and economic relations with the U.S. under a U.S. scheme *vis-a-vis* under a global scheme.

B. Terms of the CFS

The decision regarding terms of compensation and repayment must balance the cost of a CFS against the desired aid element. The basic question to be resolved is whether the CFS should essentially be a smoothing operation wherein upward fluctuations can be used to repay loans incurred in shortfall years with a small or non-existing grant element, or whether a significant grant element should exist for all or a subset of countries.

The critical elements to be decided regarding terms of compensation and repayment are:

(1) Whether recipient countries should be differentiated according to their level of development.

(2) Whether there be full or partial compensation of an export shortfall.

(3) Whether compensation be automatic or discretionary.

(4) What should be the trigger points for compensation and repayment.

(5) The terms for borrowing, including the grant/loan mix and the interest rate, if any.

Decisions regarding some of these elements are important only in determining the cost and structure of the CFS. Decisions on others, however, have implications for production incentives and resource allocation policies. For example, the implications of the question of full or partial compensation extend beyond the issue of cost. Governments should at least feel part of the impact of a shortfall in export earnings

so that there is some pressure to implement policies directed toward diversification and improved overall performance. Furthermore, full compensation is probably not necessary if the purpose of a CFS is to preserve a country's import capacity for development purposes. Imports naturally tend to decline as a result of a decline in the imported inputs of the exporting industry.[21] Part of this decline can probably occur without causing a drastic fall in the rate of growth of a country. The other objective of a CFS of avoiding drastic shortfalls in national income due to export shortfalls and disruption in development programs can probably also be met with partial compensation. The economies of developing countries can partly adjust to declines in national income without a great deal of disruption as government programs have some degree of flexibility.

Differentiating countries according to their levels of economic development likewise involves issues other than that of financial costs. One could argue on simple equity grounds that the poorest countries should benefit most from a CFS. It is possible that unless some measures are taken the benefits of a CFS would be highly skewed in favor of the larger and more wealthy countries. More liberal terms of compensation and repayment for the poorest countries can help to minimize this possibility. A further reason for differentiating countries according to their level of economic development is that with a limited amount of

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[21] M. Fleming, R. Rhomberg, and L. Boissonneault. "Export Norms and their Role in Compensatory Financing", IMF Staff Papers, 1963, pp. 143-146.

funds for financing shortfalls, the scheme should help more the countries least flexible in adjusting to export earnings instability. In order to estimate the sensitivity of the total cost of a CFS to changes in the terms of compensation and repayment, various cases were simulated for the years 1959-1972. Costs were estimated for the cases of full and two-thirds compensation of export earnings shortfalls. The trigger for compensation was set at a 7.5 percent shortfall for countries with over $200 GNP per capita in 1972 and 2.5 percent for countries below (identical to the STABEX triggers). Simulations were also run for both an all loan program and for a grant/loan program with the poorest countries not required to repay. The interest rate was varied from a level of 2 percent to interest-free loans. A scheme was also simulated for countries only under $500 GNP per capita as opposed to the $1,000 GNP per capita cutoff.

C. Measurement of Export Earning Fluctuations

A CFS is designed to stabilize export earnings along a medium-term trend. The objective is to help beneficiary countries adjust to export earning shortfalls in any one year when compared to the export levels of immediately adjacent years. This raises the issue of the appropriate way of measuring the medium-trend in export earnings. The two most common methods used in empirical studies or in actual schemes have been variants of moving averages or regression analysis.

The IMF staff has argued that for the purposes of short-term export earnings stabilization, it is desirable to find a moving norm or trend which yields positive and negative deviations from a trend that

approximately balance over a short period of time (e.g., five years).[22/] This is a reasonable rule since the relevant reference period for an exporting country suffering a shortfall is its earnings experience of the immediately preceding and subsequent years. Symmetric treatment of surpluses and shortfalls can be accomplished by the measurement of a medium-term trend based on the recent past and immediate future. Including forecasts of future years in the measurement of the trend insures that the moving average estimate does not lag continuously behind actual exports. This lag causes a problem if there is a persistent long-run trend in actual exports. If the trend is upward, the lag causes positive deviations of actual exports from the norm to predominate; if the trend is downward, negative deviations will be the rule.[23/] The IMF concluded that for these reasons the best measure of the trend consisted of a moving average of actual exports over a small number of years symmetrically distributed before and after the year of concern. In actual practice the IMF Facility has used a five-year moving average centered on the mid-point year.

Another possible reason for preferring a moving average centered on the mid-point year over a system which compares a year to the moving average of previous years is related to the economic incentives given to the beneficiary countries. A scheme which does not include future years in the moving average will consistently compensate countries which

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22/ Ibid.

23/ This point is clearly supported by estimates of fluctuations of Latin American export earnings to the United States and to all destinations for the period between 1965 and 1972, which are discussed in Lorenzo Perez, Analysis of the Export Earnings Fluctuations of Latin American Countries, unpublished A.I.D. study.

experience a long-run downward trend in commodity earnings, whereas a scheme including future years will not. Compensating for a long-run downward trend in export earnings is undesirable both because it obviates the purpose of the scheme which is to compensate for short-run fluctuations and also because it may provide some disincentive to diversify into other product lines with more promising long-run growth prospects. The disincentive argument is questionable, however, since persistent long-run downward trends in commodity earnings are probably not very common and also because a CFS will not change the long-run downward trend in earnings which should still encourage diversification.

The recently signed STABEX scheme uses a moving average based only on past years (i.e., the four years preceding the year of concern). A possible advantage of this type of scheme is that it avoids the problems associated with having to forecast future year's export earnings. In periods of relatively stable international markets, export earnings forecasts of one or two years might be fairly reliable, but forecasts of years such as 1973 and 1974 undoubtedly would have been substantially underestimated. The danger of underestimating forecast years and consequently shortfalls is greater if upper bounds are placed on forecast years such as in the IMF scheme.

An alternative to moving averages in measuring trends is the use of regression techniques.[24/] Regression analysis is the more appropriate

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24/ There are other more sophisticated statistical techniques to measure fluctuations from trends such as harmonic regressions and spectral analysis. These techniques were not used in this study because of insufficient country-commodity observations and the impracticality of suggesting international discussion of schemes based on more complicated statistical techniques.

technique when estimating a time-series trend over a long period since it takes into account all the available information. If there is a constant rate of growth during the analyzed period, a moving average gives the same results as a regression equation in measuring the trend in a time series. But in a period when the rate of change in the trend does not remain constant, the moving average will probably reflect better the short-term financial impact of an export earnings shortfall. As argued above, the relevant reference period for measuring this short-term financial impact are the immediately adjacent years.

In the empirical work of Section V, this study uses the moving average technique to measure the trend in export earnings. This measure gives a reasonable estimate of the medium-term trend and its application is easily understood. On theoretical grounds a five-year moving average centered on the mid-point year is preferable to a moving average based only on past years. However, since the latter method was adopted in STABEX and does not require forecasts, this study will use both in order inter alia to test the sensitivity of the operation of a CFS to the method of estimating shortfalls.

Since one of the basic goals of a compensatory financing scheme is to compensate for fluctuations in import capacity, this raises the issue whether the export earning shortfalls should not be calculated in real purchasing power terms. If the prices of the imports of the beneficiary countries have risen very fast, shortfalls estimated in nominal prices might not reflect the changes in purchasing power. It would be more appropriate to deflate the export earnings data of developing countries by a price index of their imports before estimating the shortfalls.

Once the shortfalls are calculated in real purchasing power terms, the necessary compensation is calculated by multiplying the shortfall amount by the import price index to convert the shortfall estimate back to nominal prices.

In the case of schemes using deflated export earnings, a shortfall could be recorded not only when a fall in nominal export earnings take place but also when there is a sudden burst of inflation in the year in question which reduces the purchasing power of the export earnings. For this reason it is likely that a scheme based on deflated data would result in larger compensations. There are, however, some other implications of deflating by an import price index which are not immediately obvious. One is that with a constant rate of inflation the same amount of compensation is estimated in a scheme using deflated data as in one which uses undeflated data. Another is that when using a moving average which includes future years, in periods of rising inflation the estimated shortfalls would be smaller using deflated data. Deflating the export earnings, therefore, does not necessarily generate a larger amount of financial flows to beneficiary countries.

When deflating the export earning data a separate import price index should be used for each country which takes into account the import composition of each country. Unfortunately very few countries have adequate import price data. Most available indexes are unit value indexes which are not highly correlated with transaction prices which are the indexes needed to measure purchasing power changes.[25/] Despite these

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25/ See Kravis and Lipsey (1971) for a discussion of these problems.

problems we decided to simulate some of the schemes on a deflated and undeflated basis. We limited this work to the simulations done at the total export earnings level for the IMF Facility reported in Section VI. The simulations done in Section V which analyzes the differences between total export earnings and commodity schemes were done on undeflated data.

The import price index used in deflating the data is a unit value index of the exports of SITC categories 5-8 inclusive of six major OECD countries. The indices are adjusted for exchange rate changes and include freight rate charges.[26/] Using the same index for all beneficiary countries has the problem that the index might not reflect very well the import composition of some countries. In addition, the price index does not include prices of food and raw materials which constitute a significant percentage of imports for some countries.

26/ This price index was provided to us by the World Bank Commodities Division.

V. Estimates of the Costs and Benefits of Various Alternative Compensatory Financing Schemes

This section compares and analyzes the costs of various alternative types of compensatory financing schemes through simulation of their operations for the period 1959 through 1972. A number of comments are warranted on the nature of these simulations: (1) the simulations assumed perfect foresight in the cases where the moving average estimates included future years since actual trade data were used which would not be available in the regular operations of the scheme; (2) the costs and benefits estimates are maximum estimates in the sense that if shortfalls actually occured according to the chosen statistical criterion, it was assumed that financing of the shortfalls would have taken place. In other words, the simulations were done without discretionary provisions. To the extent that a scheme is implemented with discretionary provisions the costs and the benefits would be reduced accordingly; (3) the simulations also assumed that the operations of the compensatory financing scheme did not directly affect the export earnings pattern of the beneficiary countries. This is obviously a restrictive assumption, given the economic interdependence of trading partners. Compensation of shortfalls will maintain income levels which could in turn affect trade flow patterns resulting in different exports trends. However, it is difficult to determine the sensitivity of these results to this assumption without simulating macroeconometric models with fully specified trade sectors of the countries in the scheme. This approach was beyond the scope of this study.

Two measures of costs are used in analyzing the simulations: the average annual net cash flow (drawing minus repayments) and the average annual outstanding balance. These two cost measures do not necessarily reflect the benefits to recipient countries. For example, if a country had repayed all its loans by the end of the sample period, the average annual net cash flow would be zero. Yet the country certainly benefitted from the scheme. A better measure of benefits is the annual average drawing or total drawings.[27/] This method of measuring the benefits to recipient countries is, of course, not meant to reflect the grant equivalent of the scheme but merely the extent to which the scheme was used by a country. The portion of the drawings represented by grants will be presented separately.

This section estimates the costs of two basic types of scheme, one with the OECD countries as donors and another with the United States as the only donor. Only exports to the donors are included in the respective schemes. The estimates distinguish between schemes based on total export earnings and major individual commodity export earnings. In addition, different degrees of shortfall compensation and financial triggers are considered. Conclusions are reached about the relative advantage of different schemes according to different objectives.

27/ Since the average annual outstanding balance shows to what extent funds are tied up in a particular country, it is in fact both a measure of costs and benefits.

In the multilateral compensatory financing scheme, the donors are all OECD countries, except Turkey.[28/] This group of developed countries include the likely donor countries of any multilateral scheme. In the simulations OECD import trade statistics were used which provided a consistent source for both overall trade statistics and individual commodity export earnings at a disaggregated level (at least the four digit SITC level). In addition, the OECD data provide equivalent series for United States import data. In 1972 the exports of the developing countries in the study to the OECD countries accounted for 79 percent of the countries' total export earnings.

There were some gaps in the data, particularly in the early years for the African countries. There were two options in dealing with these missing data: either to exclude those countries for the years the data were missing or to estimate the missing observations. The latter option was chosen which entailed using a scanning procedure to fill the data gaps. Two steps were followed: (a) In cases where there were middle years' data missing, estimates were computed which were a function of the movement of the series between the two surrounding years' values, (b) If data were missing at the beginning or end of the series, the value of the nearest

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28/ The OECD countries are Canada, United States, Japan, Australia, the enlarged European Economic Community, Austria, Finland, Greece, Iceland, Norway, Portugal, Sweden, Switzerland and Yugoslavia. It is likely that some of these countries might not be capable or willing to participate as donor countries in a multilateral scheme (e.g., Greece, Portugal and Yugoslavia). Although Turkey was considered a beneficiary country, OECD overall imports used in the simulations included Turkish imports which should not significantly affect the results.

available year was used. These two steps ensured that no fluctuations were recorded as a result of missing data.

In the simulations of both multilateral and U.S. schemes, four cases were differentiated:

Loan Scheme

Beneficiary countries are those with a GNP per capita of $1000 or less in 1972. If there is an export earnings shortfall of greater than 7.5 percent from the medium-term trend, a country qualifies for compensation. Simulations were done for 100 percent compensation and less. The latter resulted in proportional decreases of costs and benefits in all cases. The data presented in this section include only the results of 100 percent compensation. All countries repay the loans and there are no interest charges. Loans are repayed in five annual installments as long as there are upward fluctuations exceeding 7.5 percent of the trend value. If the 7.5 percent trigger is fulfilled, the upward fluctuation is used to repay the loan as long as the payment does not exceed one fifth of the loan. If a new shortfall occurs during the five year period requiring additional compensatory financing, another loan is made and the debt is rescheduled for a new five year period. Differential treatment is provided for the countries with GNP per capita of less than $200 in 1972 by allowing them to use a trigger of only 2.5 percent deviation from the trend in calculating a compensable shortfall. The 7.5 percent trigger is kept for these countries in determining when part of an upward fluctuation from the trend is to be used to repay previous loans.

Loan-Grant Scheme

Identical to the Loan Scheme except that countries with less than $200 GNP per capita are not required to repay drawings.

Middle and Low Income Country Scheme

Identical to Loan-Grant Scheme except that countries with more than $500 GNP per capita in 1972 are excluded from the scheme. This eliminates Brazil, Chile, Costa Rica, Jamaica, Panama, Peru and Uruguay. The countries with less than $200 GNP per capita do not repay and those between the $200 and $500 GNP per capita range repay loans at concessional rates.

Low Income Country Scheme

Only countries with less than $200 GNP per capita are eligible and they draw from the scheme completely on a grant basis. This is in fact the grant part of the Loan-Grant Scheme case since all the other rules are identical. These results are appropriate for considering a scheme completely designed for the poorest developing countries.

A. Multilateral CFS Results

Table II shows the overall estimated costs and benefits of these four cases of compensatory financing schemes.[29/] The simulations which used the five year moving average estimated the cost of compensating for earnings shortfalls for only between 1961 and 1971. This method of measuring the

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29/ The results in Table II and in the results following present average annual estimates calculated in current dollars in each shortfall year.

TABLE II

Estimated Costs and Benefits of the Operations of Alternative Compensatory Financing Schemes During the 1960s and Early 1970s*
(Millions of Current Dollars)

	5-Year Moving Average (1961-1970)			4-Year Moving Average (1963-1972)		
	Average Annual Drawing	Average Annual Net Cash Flow	Average Annual Outstanding Balance	Average Annual Drawing	Average Annual Net Cash Flow	Average Annual Outstanding Balance
Total Exports						
Loan Scheme	297	228	1395	228	193	730
Loan-Grant Scheme	297	272	1611	228	206	780
Middle-Low Income Country Scheme	265	237	1367	189	168	717
Low Income Country Scheme	194	194	1058	134	134	469
Individual Commodities						
Loan Scheme	274	202	1147	438	380	1540
Loan-Grant Scheme	274	237	1292	438	392	1588
Middle-Low Income Country Scheme	249	218	1153	385	349	1461
Low Income Country Scheme	145	145	759	200	200	733
Commodities as a Group						
Loan Scheme	211	150	801	329	285	976
Loan-Grant Scheme	211	182	934	329	300	1012
Middle-Low Income Country Scheme	189	164	814	285	263	924
Low Income Country Scheme	129	129	647	183	183	518

*Cases are described in the text.

trend loses two years at the end when calculating the moving average.[30] The simulations using the four year moving average measure fluctuations for 1963 through 1972 since the first four years of observation are lost in the measurement of the trend. The average annual drawings, average annual net cash flows, and the average annual outstanding balances for the period of the estimation are presented for both methods of measuring the shortfalls. The results are presented for the full compensation case.[31] Table II also presents three approaches to export earnings stabilization: total export earnings to the OECD, individual commodity earnings to the OECD, and individual commodity earnings as a group to the OECD. The second alternative entails stabilizing the individual commodity export earnings shown in Appendix II. In the third alternative, individual commodity exports are added together and the fluctuations are then estimated. This results in some offsets of the individual commodity export fluctuations.

30/ It should be mentioned that when a five year moving average is used in practice and two years are forecast there might be some restriction placed on the forecasts, e.g. the IMF scheme forecast restriction which does not allow the average of the two forecast years to exceed by more than ten percent the average of the first two years in the period. The simulations in this study assumed perfect forecasting ability which probably tends to show the maximum compensable shortfalls during a period of rapidly rising export earnings as was frequently experienced in the sixties and early seventies.

31/ It was argued before that full compensation is not warranted but for comparison purposes with the operation of the IMF scheme we present the complete compensation case. Our results show that financial flows would be reduced proportionately if there is less than 100 percent compensation.

Simulation Results Summarized in Table II[32/]

(1) The benefits received by the eligible countries as measured by the average annual drawings are larger for the total exports alternative than for the other two alternatives. This result is somewhat surprising because one might expect that the frequency of shortfalls at the total export level would be smaller than at the individual commodity. Total export earnings (including manufactures) grew at a significantly higher rate than commodity exports in the 1960's and including manufactured exports in the series should increase its stability. The results suggest that although there is probably a reduction in the frequency of fluctuations at the total export level, the fact that the same percentage shortfall involves a larger value in the total export series produces a larger average drawing. Another possible explanation is that with total export earnings of many countries increasing at a faster rate than commodity earnings during the 1960's, a shortfall computed on the mid-point year of a five-year moving average will be larger for total export earnings data when future years are used.

(2) The differences in drawings in the three alternative levels are not very significant within each scheme as shown in Column 1. Average annual drawings range between $211 million

32/ Points 1 through 5 only refer to the results using the five-year moving average.

(commodities as a group) to $297 (total exports) for the Loan and Loan-Grant Schemes. Drawings for the middle-low income scheme range between $265 million to $189 million. Low income country scheme drawings go as high as $194 million at the total export level and down to $129 million for the group of commodities.

(3) Concerning the benefits received under the different schemes, the results show the Loan and the Loan-Grant schemes with the higher drawings, followed by the other two schemes. It should be remembered that although the Loan and the Loan-Grant Schemes necessarily have the same average drawings, they do not represent the same benefits to the poorest countries since these countries draw on a grant basis in the latter. Average drawings are not much reduced when eligible countries are limited to those with an income per capita of $500 or less. It is also true that the costs are not reduced much if the Middle-Low Income Country Scheme is adopted rather than the Loan-Grant Scheme. Low Income Country Scheme benefits are equivalent to the grant benefits in the Loan-Grant Scheme. Comparing the results of these two schemes, one sees that almost two-thirds of the Loan-Grant Scheme drawings are made on a grant basis at the total export level, about half at the individual commodity level, and around sixty percent at the commodity group level.

(4) The magnitude of the costs for the decade of the sixties appears to be of a manageable nature. The cost measures (net flow and the outstanding balances) under the five year moving average method generally follow the same pattern as the drawings. The results show that the average annual financial costs only rise by around 20 percent when the poorest countries are exempted from repayment (differences between the Loan and the Loan-Grant Schemes). Costs are not dramatically different between the Loan-Grant Scheme and between the Middle-Low Income Country Scheme or between schemes based on total exports or on individual commodities. The financing cost of the Loan-Grant Scheme is applied to the other two trade levels. However, the benefits as measured by the drawings fall by approximately the same percentage. It thus seems that the benefit-cost ratio seems to be similar in this scheme for all three alternatives.

(5) The overall net cash flow and outstanding balance figures for the Middle-Low Income Country Scheme reported in Table II do not include the 3-5 percent annual interest payments. At the total export level, average annual interest payments for all countries amount to $3.4 million, at the individual commodities level $5.7 million, and at the level of commodities as a group $4.2 million. As one might have expected, the interest payments do not reduce substantially the cost of the scheme. Similar results are obtained in the simulations of Case C using the four-year moving average.

(6) Regarding the average annual drawings under the four-year moving average, the benefits are substantially larger if the schemes are implemented at the level of individual commodity exports. This differs from the results of the five-year moving average estimations. With the four-year moving average method, a year's value is compared to the average of the previous four years. The measured shortfalls will tend to be larger with this method than with a method which takes into account future years if the export earning trend is downward for some periods of time. It is more likely to find a downward trend in individual commodity earnings than in total earnings.

Simulation Results Summarized in Table III and IV

Table III contains a country and regional breakdown of the costs (average annual net cash flows) and benefits (average annual drawings) for the Loan-Grant Scheme with the five-year moving average. Table IV presents the same data with the four-year moving average method. The individual country results are presented only for this scheme because it has both groups of beneficiary countries (those with more and with less than $200 GNP per capita) and contains differential treatment for the poorest developing countries.

TABLE III

Allocation of Costs and Benefits: Loan-Grant Scheme
(Five-Year Moving Average)
(Millions of Current Dollars)

Country	Total Exports		Individual Commodities		Group of Commodities	
	Avg Annual Net Cash Flow	Avg Annual Drawing	Avg Annual Net Cash Flow	Avg Annual Drawing	Avg Annual Net Cash Flow	Avg Annual Drawing
Cameroon	0.0	0.0	2.9	3.4	1.7	1.7
Central Afr. R.	0.0	0.0	0.0	0.0	0.0	0.0
Chad	0.0	0.0	0.0	0.0	0.0	0.0
Congo-Brazzaville	0.6	0.6	0.1	0.1	0.1	0.1
Dahomey	1.0	1.0	0.5	0.5	0.5	0.5
Egypt	4.0	6.3	0.9	0.9	0.9	0.9
Ethiopia	2.1	2.1	4.3	4.3	2.6	2.6
Ghana	5.3	6.7	5.5	7.1	4.8	6.0
Guinea	1.9	1.9	1.2	1.2	1.2	1.2
Ivory Coast	7.2	8.1	12.8	13.9	6.5	9.2
Kenya	4.2	4.2	4.5	4.5	3.3	3.3
Liberia	5.9	8.0	2.5	4.4	2.1	4.1
Madagascar	2.7	2.7	2.0	2.0	1.5	1.5
Malawi	1.4	1.4	0.5	0.5	1.2	1.2
Mali	1.0	1.0	0.7	0.7	0.6	0.6
Mauritania	4.1	4.1	3.5	3.5	3.5	3.5
Morocco	3.5	3.5	0.8	0.8	0.0	0.0
Niger	1.5	1.5	0.9	0.9	1.0	1.0
Senegal	0.9	0.9	1.4	1.7	1.4	1.7
Sierra Leone	8.1	8.1	9.3	9.3	9.0	9.0

Country	Total Exports		Individual Commodities		Group of Commodities	
	Avg Annual Net Cash Flow	Avg Annual Drawing	Avg Annual Net Cash Flow	Avg Annual Drawing	Avg Annual Net Cash Flow	Avg Annual Drawing
Somalia	1.0	1.0	1.0	1.0	0.8	0.8
Sudan	4.7	4.7	4.8	4.8	3.9	3.9
Tanzania	0.6	0.6	2.6	2.6	2.2	2.2
Togo	3.2	3.2	1.8	1.8	1.1	1.1
Tunisia	6.6	6.6	2.8	3.2	2.8	3.2
Uganda	5.6	5.6	7.1	7.1	5.0	5.0
Upper Volta	0.5	0.5	0.2	0.2	0.2	0.2
Zaire	20.7	20.7	15.3	15.3	15.3	15.3
Zambia	12.8	19.9	10.0	15.6	10.0	15.6
TOTAL AFRICA	111.1	124.9	99.9	111.3	83.2	95.4
Bolivia	0.8	1.6	0.9	1.5	0.7	1.4
Brazil	13.5	13.5	4.6	7.0	6.9	6.9
Chile	2.9	4.5	3.9	6.4	3.9	6.4
Colombia	3.8	4.7	7.0	9.3	7.0	9.3
Costa Rica	1.4	1.7	3.1	3.2	1.0	1.0
Dominican R.	5.1	5.9	9.0	9.7	7.1	8.0
Ecuador	4.2	5.3	4.2	5.4	3.1	4.3
El Salvador	2.0	2.5	3.7	4.6	0.8	1.2
Guatemala	3.3	3.6	5.2	5.6	3.1	3.3
Guyana	4.7	6.7	1.9	1.9	0.4	0.4
Haiti	1.5	1.5	1.4	1.4	0.6	0.6
Honduras	3.8	4.9	2.2	3.9	2.1	3.2

Country	Total Exports		Individual Commodities		Group of Commodities	
	Avg Annual Net Cash Flow	Avg Annual Drawing	Avg Annual Net Cash Flow	Avg Annual Drawing	Avg Annual Net Cash Flow	Avg Annual Drawing
Jamaica	3.1	3.1	0.0	0.0	0.0	0.0
Nicaragua	3.2	3.6	3.2	3.5	2.0	2.0
Panama	5.1	5.7	1.3	1.6	1.3	1.6
Paraguay	1.0	1.0	0.7	0.8	0.5	0.5
Peru	0.0	0.0	1.7	3.3	1.7	3.3
Uruguay	2.8	3.4	4.3	5.5	3.0	3.2
TOTAL LATIN AMERICA	62.2	73.2	58.3	74.6	45.2	56.6
Afghanistan	4.1	4.1	0.8	0.8	0.8	0.8
Bangladesh/Pakistan	10.6	10.6	11.1	11.1	4.3	4.3
Burma	4.1	4.1	0.8	0.8	0.8	0.8
India	10.2	10.2	17.2	17.2	10.7	10.7
Indonesia	42.8	42.8	10.2	10.2	10.2	10.2
Malaysia	0.0	0.0	7.4	10.9	3.5	5.5
Philippines	7.7	7.7	12.3	15.3	4.5	6.1
Sri Lanka	3.6	3.6	3.4	3.4	8.6	8.6
Syria	4.3	4.3	1.7	2.5	1.7	2.5
Thailand	6.4	7.1	6.8	7.1	1.9	2.1
Turkey	2.9	2.9	6.7	8.1	6.4	7.2
Yemen	1.9	1.9	0.2	0.2	0.1	0.1
TOTAL ASIA	98.6	99.3	78.6	87.6	53.5	58.9

	Total Exports		Individual Commodities		Group of Commodities	
	Avg Annual Net Cash Flow	Avg Annual Drawing	Avg Annual Net Cash Flow	Avg Annual Drawing	Avg Annual Net Cash Flow	Avg Annual Drawing
	(Proportional Distribution)					
AFRICA	.41	.42	.42	.41	.46	.45
LATIN AMERICA	.23	.25	.25	.27	.25	.27
ASIA	.36	.33	.33	.32	.29	.28

(1) The regional distribution of benefits and costs in Table III is not substantially different whether total or commodity earnings are stabilized. Africa accounted for approximately 42 percent of the cost and benefits, Latin America is 25 percent, and Asia is 33 percent. The only exception to this distributional pattern is the case when commodities are treated as a group with the Asian share being reduced by around four percent in favor of Africa.

(2) Africa has a larger average annual drawing when total export earnings are stabilized than in the other two alternatives (see page 41), and Latin America when either total export earnings or individual commodities are compensated with substantially less when commodities are treated as a group Asia also has larger average drawings when total export earnings are stabilized and substantially less when commodities as a group are stabilized. The larger beneficiaries in the case of Africa are Egypt, Ghana, Ivory Coast, Liberia, Zaire and Zambia for most of the three trade levels, especially Zaire and Zambia which together account for close to thirty-three percent of the benefits. The main commodity export for these two countries is copper. In Latin America, Brazil, Chile, Costa Rica, Ecuador, El Salvador, Panama and Uruguay are the large recipients. In Asia, Indonesia, Bangladesh-Pakistan, India and the Philippines account for most of the funds.

(3) At the country level it makes a difference whether total or individual commodity exports are being stabilized. For example, Egypt, Morocco, Togo, Tunisia, Zaire, Brazil, Panama, Afghanistan, and Indonesia, inter alia, benefit more if total export earnings are stabilized than individual commodities. On the other hand, Cameroon, Ivory Coast, Upper Volta, Chile, Costa Rica, Dominican Republic, Malaysia, Philippines, and Turkey benefit more if individual commodity earnings are stabilized. No particular pattern of results by commodity exports is easily discernible among these countries.

(4) In the case of the four-year moving average method the Asian and the African benefit shares vary substantially depending on the level of export earnings which are stabilized as shown at the bottom of Table IV. The African share of the benefits is reduced from a level of 55 percent in the case of total exports to around 38 percent at the level of individual commodity earnings. The Asian countries' benefit share, on the other hand, rises from 19 percent with total exports to around 32-36 percent when individual commodities are stabilized. This is probably because the Asian countries have relatively slowly growing individual commodity exports and more shortfalls are observed in the four-year moving average.

(5) Regarding individual country results, Egypt, Sierra Leone, Tunisia, Zaire, Chile, Afghanistan and Syria receive a larger amount of benefits when total export earnings are stabilized. On the other hand Ghana, Ivory Coast, Senegal, Sudan, Tanzania, Uganda, Dominican Republic, Honduras, Nicaragua, Panama, Bangladesh-Pakistan, India, Philippines and Sri Lanka, receive larger benefits if individual commodity earnings are stabilized. For some countries like Honduras, Bangladesh-Pakistan, India and Indonesia, compensation ranges from substantial amounts with individual commodity exports to zero with total exports.

(6) Under the four-year moving average method the large benefit recipients in Africa are Senegal, Sierra Leone, Zaire and Zambia, especially the latter two which account for between 25% to 33% of the drawings. In the case of Latin America the most important beneficiary when total export earnings are stabilized is Chile which accounts for more than two-thirds of the drawings. In the case of individual commodity earnings Chile Bolivia, Uruguay, Dominican Republic, Honduras and Brazil are the most important beneficiaries.

TABLE IV

Allocation of Costs and Benefits: Loan-Grant Scheme
(Four-Year Moving Average)
(Millions of Current Dollars)

	Total Exports		Individual Commodities		Group of Commodities	
	Avg Annual Net Cash Flow	Avg Annual Drawing	Avg Annual Net Cash Flow	Avg Annual Drawing	Avg Annual Net Cash Flow	Avg Annual Drawing
Country						
Cameroon	0.0	0.0	1.1	1.2	0.0	0.0
Central Afr. Rep.	0.3	0.3	0.3	0.3	0.3	0.3
Chad	0.1	0.1	0.2	0.2	0.2	0.2
Congo Brazzaville	0.0	0.0	0.0	0.0	0.0	0.0
Dahomy	0.2	0.2	1.7	1.7	1.4	1.4
Egypt	5.1	6.4	1.4	1.4	1.4	1.4
Ethiopia	0.0	0.0	1.4	1.4	0.5	0.5
Ghana	2.5	4.9	9.2	13.7	4.1	8.1
Guinea	1.4	1.4	1.9	1.9	1.4	1.4
Ivory Coast	0.0	0.0	9.6	9.8	0.0	0.0
Kenya	9.0	9.1	10.7	10.7	9.5	9.5
Liberia	0.0	0.0	0.0	0.0	0.0	0.0
Madagascar	1.1	1.1	1.5	1.5	0.8	0.8
Malawi	0.1	0.1	0.0	0.0	0.0	0.0
Mali	1.2	1.2	0.8	0.8	0.7	0.7
Mauritania	0.0	0.0	0.0	0.0	0.0	0.0
Morocco	0.0	0.0	0.3	0.4	0.0	0.0
Niger	0.0	0.0	1.8	1.8	1.8	1.8
Senegal	4.2	5.3	11.8	12.5	11.8	12.5
Sierre Leone	12.9	12.9	10.4	10.4	9.8	9.8

Country	Total Exports		Individual Commodities		Group of Commodities	
	Avg Annual Net Cash Flow	Avg Annual Drawing	Avg Annual Net Cash Flow	Avg Annual Drawing	Avg Annual Net Cash Flow	Avg Annual Drawing
Somalia	2.2	2.2	3.1	3.1	2.5	2.5
Sudan	1.2	1.2	6.5	6.5	3.7	3.7
Tanzania	5.2	5.2	7.4	7.4	8.4	8.4
Togo	0.5	0.5	1.9	1.9	0.0	0.0
Tunisia	2.8	4.4	2.5	3.9	2.5	3.9
Uganda	0.0	0.0	3.5	3.5	0.3	0.3
Upper Volta	0.0	0.0	0.0	0.0	0.0	0.0
Zaire	24.0	24.0	20.6	20.6	19.0	19.0
Zambia	44.4	44.4	46.4	46.4	46.4	46.4
TOTAL AFRICA	118.3	124.4	156.0	163.0	126.5	132.6
Bolivia	5.2	5.2	4.2	4.2	3.7	3.7
Brazil	0.0	0.0	4.2	8.2	2.9	7.1
Chile	35.3	35.3	25.6	25.6	25.6	25.6
Colombia	1.6	4.0	1.7	3.3	1.7	3.3
Costa Rica	0.0	0.0	0.6	1.2	0.0	0.0
Dominican Republic	2.0	6.2	13.2	19.5	11.5	19.1
Ecuador	0.0	0.0	0.8	1.2	1.1	1.4
El Salvador	0.7	1.4	2.6	4.8	2.1	4.0
Guatemala	0.8	1.5	2.6	4.1	1.2	2.3
Guyana	0.0	0.0	3.7	5.8	0.0	0.0
Haiti	0.9	0.9	2.3	2.3	1.5	1.5
Honduras	0.0	0.0	13.0	13.4	11.2	11.2
Jamaica	0.0	0.0	1.3	1.3	1.3	1.3
Nicaragua	0.0	0.0	3.8	4.7	0.6	0.9
Panama	0.0	0.0	0.0	0.0	0.0	0.0

Country	Total Exports		Individual Commodities		Group of Commodities	
	Avg Annual Net Cash Flow	Avg Annual Drawing	Avg Annual Net Cash Flow	Avg Annual Drawing	AAvg Annual Net Cash Flow	Avg Annual Drawing
Paraguay	0.4	1.0	0.4	0.7	0.2	0.6
Peru	0.0	0.0	6.1	6.1	6.1	6.1
Uruguay	3.2	4.0	10.0	10.4	2.9	3.7
TOTAL LATIN AMERICA	50.1	59.5	96.1	116.8	73.6	91.8
Afghanistan	2.5	2.5	0.8	0.8	0.8	0.8
Bangladesh/Pakistan	0.0	0.0	20.5	20.5	5.8	5.8
Burma	7.6	7.6	1.6	1.6	1.6	1.6
India	0.0	0.0	39.6	39.6	24.3	24.3
Indonesia	0.0	0.0	11.3	11.3	11.3	11.3
Malaysia	0.0	0.0	6.0	6.0	0.0	0.0
Philippines	0.0	0.0	40.5	40.6	17.0	17.0
Sri Lanka	12.6	12.6	18.5	18.5	31.2	31.2
Syria	7.8	14.2	1.3	2.4	1.3	2.4
Thailand	0.0	0.0	8.1	9.2	2.9	3.6
Turkey	0.0	0.0	6.3	7.9	3.9	6.1
Yemen	6.2	6.2	0.4	0.4	0.4	0.4
TOTAL ASIA	36.7	43.1	154.9	158.6	100.5	104.3

Country	Total Exports		Individual Commodities		Group of Commodities	
	Avg Annual Net Cash Flow	Avg Annual Drawing	Avg Annual Net Cash Flow	Avg Annual Drawing	Avg Annual Net Cash Flow	Avg Annual Drawing
AFRICA	.58	.55	.38	.37	.42	.40
LATIN AMERICA	.24	.26	.24	.27	.25	.28
ASIA	.18	.19	.38	.36	.33	.32

B. A United States CFS

Estimates were prepared for the costs and benefits of a CFS with a single country as donor--in this case, the United States. Table V presents the estimates for total exports to the U.S. (the data for "individual commodities" and "commodities as a group" contained too many gaps for the purposes of this table). The costs for a U.S. scheme ranges from approximately one-third to one-half of the cost of the multilateral scheme depending on which measure is used. This may seem high when one considers that the U.S. only purchases approximately 20 percent of total developing country exports to the OECD countries. The higher relative cost may be explained by the fact that exports to one destination will tend to be more unstable than exports to many destinations, since changes in import demand among countries will offset each other to the extent that business cycles are not synchronized.

A difference between the U.S. scheme and the multilateral scheme is that in the former the costs and benefits of the four-year moving average method are greater than the five year moving average method when compensating total export earnings. This reversal may be due to the particular business cycle and import demand pattern of the U.S. during the 1960's and early 1970's. For example, the four-year moving average measures shortfalls for 1971 and 1972 whereas the five-year moving average stops with 1970. The early 1970's were years of sluggish business conditions in the U.S. and considerable uncertainty with respect to the international position of the U.S. dollar. Accordingly the largest shortfall recorded using the four-year moving average method was in 1971. The regional distribution of the U.S. scheme (see Table VI) also differs from the multilateral scheme, with

Table V

ESTIMATED COSTS AND BENEFITS OF A UNITED STATES CFS

(Total Export Earnings)

(Millions of Current Dollars)

COUNTRY	5-year moving average			4-year moving average		
	Avg Annual Drawing	Avg Annual Net Cash Flow	Avg Annual Outstanding Balance	Avg Annual Drawing	Avg Annual Net Cash Flow	Avg Annual Outstanding Balance
Loan Scheme	113	87	474	140	111	629
Loan-Grant Scheme	113	97	512	140	124	680
Middle-Low Income Country Scheme	92	60	324	100	64	429
Low Income Country Scheme	45	45	215	57	57	356

Latin America becoming the largest beneficiary and Africa dropping to the smallest. This, of course, reflects the relative trade shares of these regions with the U.S. The regional shares for "total exports" are the most accurate as there are many gaps in the data (especially for Africa) for "individual commodities" and "group of commodities."

The largest individual country beneficiaries in the U.S. scheme when compensating total exports are Brazil, Indonesia, and India. When compensating for commodity exports, Brazil is still the largest (mainly due to its coffee exports) followed by the Dominican Republic, Philippines, and Sri Lanka. The case of the Philippines reflects the situation of a country with a diversified export base but still having a few large-volume commodity exports. Compensation for the Philippines ranges from zero with total exports to $9.5 million average annual drawing with individual commodity exports.

C. Conclusions

Based on the above empirical results, a number of conclusions can be reached about the desirability of various types of compensatory financing schemes, according to given objectives. The results show that the goal of providing low cost/grant financing for developing countries in years of export earning shortfalls during the sixties and early seventies could have been accomplished with a manageable cost. Schemes with an average net cash flow of less than $300 million would probably suffice (see Column 2, Table II). In addition, if one of the main objectives is to aid the poorest developing countries, the results show that a compensatory financing scheme can

TABLE VI

Country and Regional Allocation of Costs and Benefits of U.S. Scheme - Loan-Grant Scheme

(Five-Year Moving Average)

(Millions of Current Dollars)

COUNTRY	Total Exports		Individual Commodities		Group of Commodities	
	Avg. Annual Net Cash Flow	Avg Annual Drawing	Avg. Annual Net Cash Flow	Avg Annual Drawing	Avg Annual Net Cash Flow	Avg Annual Drawing
Cameroon	0.9	1.3	1.0	1.6	0.8	1.4
Central Africa Republic	0.0	0.0	n/a	n/a	n/a	n/a
Chad	0.0	0.0	n/a	n/a	n/a	n/a
Congo Brazzaville	0.0	0.0	0.0	0.0	0.0	0.0
Dahomey	0.0	0.0	n/a	n/a	n/a	n/a
Egypt	1.3	1.8	0.6	0.8	0.6	0.8
Ethiopia	3.4	3.4	3.7	3.7	3.0	3.0
Ghana	2.7	4.1	3.1	4.1	2.7	3.7
Guinea	0.7	0.7	0.5	0.5	0.5	0.5
Ivory Coast	2.7	3.9	3.1	4.2	2.8	4.0
Kenya	3.5	3.5	2.7	2.7	2.5	2.5
Liberia	0.8	1.5	0.8	1.1	0.8	1.1
Madagascar	2.0	2.0	1.4	1.4	1.4	1.4
Malawi	0.2	0.2	n/a	n/a	n/a	n/a
Mali	0.0	0.0	n/a	n/a	n/a	n/a
Mauritania	0.1	0.1	n/a	n/a	n/a	n/a
Morocco	0.5	0.6	n/a	n/a	n/a	n/a
Niger	0.0	0.0	n/a	n/a	n/a	n/a
Senegal	0.1	0.1	n/a	n/a	n/a	n/a
Sierra Leone	1.7	1.7	0.5	0.5	0.5	0.5

COUNTRY	Total Exports		Individual Commodities		Group of Commodities	
	Avg Annual Net Cash Flow	Avg Annual Drawing	Avg Annual Net Cash Flow	Avg Annual Drawing	Avg Annual Net Cash Flow	Avg Annual Drawing
Somalia	0.1	0.1	n/a	n/a	n/a	n/a
Sudan	0.9	0.9	0.6	0.6	0.6	0.6
Tanzania	0.6	0.6	0.7	0.7	0.7	0.7
Togo	1.6	1.6	n/a	n/a	n/a	n/a
Tunisia	0.5	0.6	0.2	0.2	0.2	0.2
Uganda	1.3	1.3	1.1	1.1	1.1	1.1
Upper Volta	0.0	0.0	n/a	n/a	n/a	n/a
Zaire	1.7	1.7	n/a	n/a	n/a	n/a
Zambia	2.4	2.7	n/a	n/a	n/a	n/a
TOTAL AFRICA	29.7	34.4	20.0	23.2	18.2	21.5
Bolivia	1.5	1.9	0.8	1.2	1.0	1.5
Brazil	9.6	10.4	15.8	16.2	9.7	11.8
Chile	1.2	1.8	1.1	2.0	1.1	2.0
Colombia	2.3	2.3	4.9	6.5	4.9	6.5
Costa Rica	1.1	1.1	1.6	1.9	1.1	1.6
Dominican Republic	3.3	4.2	7.5	9.1	5.9	7.5
Ecuador	1.8	2.5	2.3	3.1	2.3	3.1
El Salvador	0.7	0.7	1.1	1.6	1.1	1.6
Guatemala	1.3	1.4	2.2	2.4	1.9	2.0
Guyana	0.6	0.8	0.5	0.6	0.3	0.5
Haiti	1.2	1.2	1.1	1.1	0.3	0.3
Honduras	2.5	3.3	2.3	3.5	1.7	2.9
Jamaica	1.0	1.3	0.5	0.6	0.5	0.6
Nicaragua	0.7	0.7	1.0	1.1	0.8	0.8
Panama	1.0	1.6	0.4	1.1	0.4	1.1

Country	Total Exports		Individual Commodities		Group of Commodities	
	AVG Annual Net Cash Flow	Avg Annual Drawing	Avg Annual Net Cash Flow	Avg Annual Drawing	Avg Annual Net Cash Flow	Avg Annual Drawing
Paraguay	0.4	0.5	n/a	n/a	n/a	n/a
Peru	2.1	2.6	2.0	4.2	2.0	4.2
Uruguay	1.3	2.3	1.1	1.9	1.0	1.9
TOTAL LATIN AMERICA	33.6	40.6	46.2	58.1	36.0	49.9
Afghanistan	1.4	1.4	n/a	n/a	n/a	n/a
Bangladesh/Pakistan	2.6	2.6	2.2	2.2	1.8	1.8
Burma	0.2	0.2	n/a	n/a	n/a	n/a
India	8.7	8.7	5.6	5.6	4.4	4.4
Indonesia	9.2	9.2	5.5	5.5	5.5	5.5
Malaysia	3.0	3.8	1.9	3.0	1.9	3.0
Philippines	0.0	0.0	9.5	9.5	8.0	8.0
Sri Lanka	0.8	0.8	0.4	0.4	8.6	8.6
Syria	0.3	0.3	n/a	n/a	n/a	n/a
Thailand	3.7	5.7	0.9	1.5	0.9	1.5
Turkey	3.6	4.6	2.9	3.6	2.9	3.6
Yemen	0.3	0.3	n/a	n/a	n/a	n/a
TOTAL ASIA	33.8	37.6	28.9	31.3	34.0	36.4
ALL REGIONS	PERCENTAGE REGIONAL ALLOCATION OF U.S. SCHEME					
AFRICA	.31	.31	.21	.21	.21	.20
LATIN AMERICA	.35	.36	.49	.52	.41	.46
ASIA	.34	.33	.30	.17	.38	.34

accomplish this to a certain extent. In the multilateral scheme, the countries under $200 income per capita generally receive between one-half and two-thirds of total drawings depending on the particular scheme being applied. Nevertheless, there are some very poor countries which benefited very little and a few (e.g., Chad and Central African Republic) which did not receive any drawings at all over the ten-year period.[33/] These countries have very small export earnings and are best helped with direct aid transfers rather than trade-linked schemes. This situation underscores the fact that the primary objective of a CFS is to stabilize export earnings. This objective can be made to favor the poor countries, but only those which have significant export instability problems.

A multilateral scheme seems to be preferable to a one-country scheme for several reasons. The cost of a one donor country scheme, as illustrated by the scheme with the U.S. as the donor, is relatively high considering the U.S. share of total OECD imports from the developing countries. A multilateral scheme is also better suited to meeting the total foreign exchange problems of individual developing countries which export to more than one destination.

The estimates of costs and benefits do not differ greatly between the cases of a four-year moving average and a five-year moving average, nor are there great differences between the cases of total exports, individual commodities, and commodities as a group. Decisions on these alternatives can

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33/ These two countries' export data had a substantial number of gaps and their lack of drawings might be partly due to this problem.

then be made exclusively with respect to how they accommodate the objectives of the CFS and their conceptual soundness. The discussion in sections III and IV concluded favoring a five-year moving average and compensating total export earnings with the provision that compensating for major commodity exports might also be consistent with a broader objective. The choice between the different schemes depends on the degree to which one wishes to differentiate in favor of the poorest developing countries and the terms of repayment.

VI. Considerations in Establishing a CFS

In the previous section, estimates of the costs and benefits of various CFS's were presented assuming they existed in the 1960's and early 1970's. This section discusses the main institutional issues that would arise if a CFS were established at the present time. First, estimates are presented for the operations of the existing and a liberalized IMF compensatory financing facility. These results are compared to the results of the schemes of the previous section. Secondly, the matter of projecting the costs and benefits estimates of Section V to the later 1970's is discussed. Finally the various possible sources of financing are examined.

A. Institutionalizing a Compensatory Financing Scheme

The simulation results of Section V suggest that a scheme of a managable size could be implemented, but that it would still involve annual financial flows in the hundreds of millions of dollars. Since these are large amounts of funds, the institutional arrangements must be considered very carefully.

It may be most feasible to use one of the existing international financial institutions to incorporate a compensatory financing scheme of the type discussed in the previous pages. Difficult political issues can be avoided in terms of voting rights, the institution's authority, relations with other existing institutions, etc. The

most likely alternatives would be to use the IMF, the World Bank or to expand the STABEX system to include other donor countries, perhaps in the framework of the OECD. The latter is probably less politically feasible since STABEX is only part of a more comprehensive aid - cooperation agreement between the European Common Market and associated developing countries and the EC might be reluctant to globalize only part of the agreement to include other donors and beneficiary countries. In addition given the hard bargaining which took place between the EC and the ACP countries in selecting the commodities to be included in STABEX it is unlikely that the EC will be interested in expanding the scheme to include other commodities. It should be clear, though, that the schemes discussed so far could be established in a number of existing institutions.

The IMF members have been discussing for sometime possible ways of liberalizing the IMF compensatory financing facility. This makes the IMF facility a very likely institution where a scheme such as the ones discussed in this study could be implemented. For this reason, additional simulations were done estimating the costs and benefits of a liberalized IMF facility during the 1960's and early 1970's to compare with the results of Section V.

The IMF compensatory financing facility has lent around $1.3 billion in nearly 12 years of operation.[34/] The facility compensates for total export earnings shortfalls and in this sense as our previous discussion suggests is more preferable to a STABEX-type of scheme. There are a number of existing contraints in the IMF scheme which have limited the amount of financing available to member countries. These contraints

34/ Estimated from IMF reports.

provide the basis for suggesting ways of liberalizing the IMF scheme.

We have done three kinds of simulation of the IMF facility. One is a simulation of the operation of the scheme under the present rules. This is necessary because it is improper to compare the results of the simulation of the liberalized scheme to the actual operation of the facility since the simulations estimate the maximum potential drawings under the scheme.[35] Hence it is necessary to simulate the maximum operation of the existing facility.

A second simulation was done of a liberalized IMF facility based on undeflated export earnings data. The liberalized facility would change the forecasting restrictions in the computation of the five-year moving average, the quota limitations, and have more generous repayment provisions for the poor countries. The way the five-year moving average is calculated frequently biases downward the estimate of the export earnings shortfall and consequently the level of compensation a member may request. This is because the two forecast years cannot be projected more than 10 percent above the average of the two pre-shortfall years.[36] For this reason, in the simulations of the liberalized IMF-scheme we changed the restriction in the forecasting formula to 20 percent.

35/ The simulation of the existing facility did not consider the drawing restriction that limits drawing under the compensatory financing facility and the IMF buffer stock facility to 75 percent of a member's quota.

36/ The average of the two forecast years can not be less than the midpoint year of the five year moving average. We do not change this forecasting rule in the liberalized version.

Drawings from the facility are currently restricted to 50 percent of a country's IMF quota. In addition, not more than 25 percent of the quota can be drawn in any one calendar year. This second quota restriction has actually proven to be an effective constraint in financing export earning shortfalls. These two rules were changed for the simulations to allow member countries to borrow up to 100 percent of quota and be able to use all its borrowing capacity in one calendar year. We also eliminated in these simulations of a liberalized IMF facility the requirements that the total outstanding drawings under the buffer stock facility and compensatory facility combined could not exceed 75 percent of quota.

In addition countries with a GNP per capita of $200 or less in 1972 could draw from the Facility on a grant basis. This is equivalent to the grant provision of the Loan-Grant Scheme of the previous section. The outstanding balances of these grants drawings could not exceed at any time the country's IMF quota. For the purpose of comparing these IMF results with those of the schemes analyzed in Section V, we only included as beneficiary countries the same beneficiaries as in the Loan and Loan-Grant Schemes except that Liberia and Guinea were not included because their data were not complete.

A third simulation was done of the same liberalized IMF facility but deflating the export earnings data by an import price index of beneficiary countries.[37/] Comparing the costs and benefits of the schemes using deflated and undeflated data gives an indication of the importance of deflating the data.

37/ This is the export price of six major OECD countries discussed at the end of Section IV.

The simulations of the IMF compensatory financing facility were done for the period 1961 through 1974. Although the IMF facility did not begin its operation until 1963, the simulation began in 1961 in order to have the same starting year as the simulations of the previous section. The simulations include 1974 in order to have the most recent year's data.[38/] The total export earnings data for developing countries as reported in the IMF's International Financial Statistics were used in these estimates.

Table VII presents the average annual drawings, average annual net cash flows and the average annual outstanding balances resulting from the simulations of existing and the liberalized IMF facilities. The results are presented for both time periods: 1961-1970 and 1961-1974.

(1) We can compare the 1961-1970 results with the total exports results of Table II. In terms of overall benefits, as measured by the annual average drawings, the results are almost identical between the liberalized IMF based on undeflated data ($294 million) and the Loan Grant Scheme ($297 million).[39/] As expected the overall annual net cash flow is smaller for this liberalized IMF facility than for the Loan-

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38/ The financing estimates for 1973 and 1974 are tentative since it was necessary to forecast export earnings for 1975 and 1976 and in some instances even 1974 when calculating the five year moving average centered in 1973 and 1974.

39/ It should be noted that the trade coverage is not exactly the same since the Loan-Grant scheme is based on total OECD imports from beneficiary countries and the IMF simulations are based on export earnings to all destinations. The comparison is valid in a practical sense because developing countries could probably only negotiate an agreement with the OECD countries as donors or in a multilateral institution like the IMF.

TABLE VII

Estimated Costs and Benefits on the Simulations of the Maximum Operations of the Existing and Liberalized IMF Compensatory Financing Facility (millions of current dollars)

	Annual Average Drawings	Average Annual Net Cash Flow	Annual Avg Outstanding Balance
1961 - 1970			
Existing IMF Facility	137	85	619
Liberalized IMF Facility- Undeflated Version	294	180	1,282
Liberalized IMF Facility - Deflated Version	283	171	1,087
1961 - 1974			
Existing IMF Facility	142	880	788
Liberalized IMF Facility- Undeflated Version	306	158	1,628
Liberalized IMF Facility - Deflated Version	364	222	1,774

Grant scheme due to the stricter repayment provisions in the IMF. A similar conclusion is reached when comparing the average annual outstanding balances of the Loan-Grant scheme and this liberalized IMF facility.

(2) The IMF estimates for both time periods show that the undeflated liberalized scheme would have approximately doubled the average annual drawing from levels of the existing IMF facility.

(3) The comparison of the deflated and undeflated versions of the liberalized schemes show two interesting results: (a) There is almost no difference between the two versions for the period 1961-1970. This is a period of relatively low rates of inflation. (b) On the other hand for the period between 1961-1974 the financial flows under the deflated version are larger since they include the period of 1971-1974 inclusive. This result highlights the fact that in a high inflation period, undeflated data could significantly underestimate the shortfalls which take place in purchasing power terms.

Table VIII presents the individual country results from the operations of the liberalized IMF facility based on undeflated data. The distribution of the benefits and costs can be compared with Table III. Africa's share of the drawings decreases to 29% from 42% in the Loan-Grant scheme. Latin America's increases slightly from 25% to 29% and Asia's

increases from a level of 33% to 42%. The cost distribution is also different in the liberalized IMF, with Asia accounting for 55 percent of the annual cost as measured by the average net cash flow. In terms of individual country benefits, a comparison of Table VIII with Table III shows that for some countries there are substantial differences. Countries which had significantly larger average drawings than the other countries in the liberalized IMF facility were Cameroon, Egypt, Ghana, Brazil, Chile, Colombia, Peru, the Philippines. These larger drawings in the IMF facility are partly explained for all these countries by the fact that the simulation presented in Table VII included the period 1971-1972 when these countries would have had large drawings. On the other hand, the results show that the IMF quota constraint proved to be a limitation for the financing of the shortfalls of some countries. This is true in the cases of the Ivory Coast, Kenya, Mauritania, Sierra Leone, Zaire, Zambia, Honduras, Panama, and Indonesia. One can conclude from these results that an IMF facility liberalized in this way might still be unable to finance a substantial percentage of a country's earnings shortfalls due to the quota limitations. In analyzing the potential benefits for eligible countries in the IMF, one would have to consider the quota sizes of these countries.

Substantially more work could be done exploring alternative ways of liberalizing the IMF facility. Changes could be made in the forecasting rules restrictions to see how sensitive the results

TABLE VIII

Allocation of Costs and Benefits of a Liberalized IMF Compensatory Financing Facility for the Period 1961 - 1975 (millions of dollars)

COUNTRY	Avg Annual Drawings	Avg Annual Net Cash Flow
Cameroon	4.0	1.9
Central Africa Republic	0.9	0.9
Chad	0.8	0.8
Congo Brazzavile	0.9	0.9
Dahomey	0.8	0.8
Egypt	16.0	3.1
Ethiopia	1.9	1.9
Ghana	10.4	3.2
Guniea 1/		
Ivory Coast	4.4	2.2
Kenya	2.6	2.6
Liberia 1/		
Madagascar	1.4	1.4
Malawi	0.8	0.8
Mali	1.0	1.0
Mauritania	0.5	0.5
Morocco	8.4	1.9
Niger	0.7	0.7
Senegal	4.1	1.3
Sierra Leone	1.9	1.9
Somalia	0.6	0.6
Sudan	3.9	3.9
Tanzania	3.0	3.0
Togo	0.9	0.9
Tunisia	2.1	0.0
Uganda	3.1	3.1
Upper Volta	0.4	0.4
Zaire	4.1	4.1
Zambia	8.0	3.9
TOTAL AFRICA	87.6	47.7

COUNTRY	Avg Annual Drawings	Avg Annual Net Cash Flow
Bolivia	0.8	0.4
Brazil	19.0	0.0
Chile	15.6	7.5
Colombia	11.3	1.8
Costa Rica	1.1	0.2
Dominican Republic	2.6	0.0
Ecuador	4.5	0.7
El Salvador	2.2	0.0
Guatemala	4.0	0.8
Guyana	1.5	0.4
Haiti	1.5	1.5
Honduras	1.2	0.3
Jamaica	2.8	1.2
Nicaragua	1.0	0.0
Panama	0.7	0.4
Paraguay	0.7	0.0
Peru	11.3	6.1
Uruguay	7.4	2.4
TOTAL LATIN AMERICA	89.2	23.7
Afghanistan	0.9	0.9
Bangladesh/Pakistan	15.3	15.3
Burma	4.2	4.2
India	27.7	27.7
Indonesia	14.4	14.4
Malaysia	22.4	8.6
Philippines	15.7	3.8
Sri Lanka	7.6	7.6
Syria	4.5	0.9
Thailand	8.3	0.8
Turkey	5.3	0.2
Yemen	2.2	2.2
TOTAL ASIA	128.5	86.6

	Avg Annual Drawings	Avg Annual Net Cash Flow
TOTAL - ALL REGIONS	305.3	158.0
PROPORTIONAL DISTRIBUTION		
AFRICA	0.29	0.30
LATIN AMERICA	0.29	0.15
ASIA	0.42	0.55

1/ Guinea and Liberia were not included in these simulations because of lack of trade data.

are to these changes. Given the strong inflationary tendencies of recent years, a 20 percent forecasting constraint might be too restrictive to forecast future export earnings in nominal terms. In addition further work could be done on the percentage of the quotas that member countries could borrow under the Fund Facility if it is liberalized. An analysis of individual countries' shortfall data reveal that if the maximum annual drawing is restricted to 75 rather than to a 100 percent of the quota, approximately 17 countries would have had their drawings restricted by this ceiling on one occassion. If the quota limitations are not liberalized as much as we have done in our simulations, the benefits to recipient countries could be significantly reduced particularly in the years where there are extraordinary shortfalls.

B. Projecting the Costs of a CFS

This study has presented estimates of the costs and benefits of various compensatory financing schemes assuming they were operating during the 1960's and early 1970's. Projecting these costs to the later 1970's and 1980's is very difficult, even with the aid of some heroic assumptions.

Before proceeding to the forecasting problems, a discussion of some of the inherent biases of the estimates is appropriate. There are two sources of upward bias in the cost estimates. First, as discussed before, the simulations assume that all qualified shortfalls are compensated, leaving no room for discretionary review of individual cases. Assuming there would be some discretionary review, the simulation presents the "maximum possible" compensation, in effect assuming that all qualified cases for compensation are requested by the receiving countries and approved. A second source of upward bias in the multilateral scheme discussed in Section V is the fact that there were no constraints on the two forecast years of the five-year moving averages. The estimates of this study assume that there existed perfect forecasting ability. During the estimation period, there were many cases of accelerating increases and large upward jumps in export earnings which probably would not have been forcast. There is also a possible source of downward bias for compensation, although less likely, which would occur if the actual data were less than the forecast amounts.

There are two major factors which should determine how the 1960's and early 1970's cost estimates should be adjusted in order to forecast future years' costs. First, with the same percentage shortfall the increased value of exports following recent strong inflationary trends will result in a greater absolute amount of compensation. Second, the future pattern and degree of export instability would have to be taken into account since it could certainly be different from that which prevailed in the 1960's.

Whether measuring total exports or major commodity exports, the average annual value of these exports in nominal terms from developing countries in the later 1970's could easily be three times the average annual value of the 1960's. During the period of the 1960's, total exports from developing countries grew in nominal terms at an average annual rate of more than 7 percent, and during 1972, 1973, and 1974 reached annual growth rates of 19, 45, and 41 percent respectively. The higher growth rates in these three years reflect mainly the boom in commodity prices which are now falling. Part of the increase, however, was a more substantial increase in manufactured exports which rose at annual rates of growth of 32 and 41 percent in 1972 and 1973.

In order to forecast the costs of a CFS, it is not appropriate merely to adjust for the scale factor since the pattern and degree of instability could be different. As manufactures begin to represent a greater share of total export earnings, overall stability should improve. In addition, it has been shown that export instability is negatively related to the size of exports in individual developing countries.[40/] Several studies have also presented evidence that export instability has declined over time since the 1940's for both developed and developing countries, but more so for the latter.[41/] The increased costs of a CFS in the future from larger exports, therefore, should probably be adjusted downward to reflect the likely reduced export instability.

40/ C.W. Lawson (1974) p.62.
41/ G.F. Erb and S. Schiavo-Campo (1969) and Lawson (1974).

The evidence cited in support of lower export instability over time did not cover the current period which has seen commodity prices climb approximately 120 percent between mid-1972 and mid-1974. Prices of agricultural commodities reached their peak in the beginning of 1974 and metals and minerals in the second quarter of 1974. By the end of 1974 the prices of most commodities had begun a sharp decline and by June, 1975 were merely 10 percent above their 1973 levels. This upsurge and fall in commodity prices was almost entirely demand induced, caused by an unusual synchronized economic boom and recession in most developed countries. Although the circumstances leading to this occurence were unusual, the possibility of a recurrence has definite implications for a compensatory financing facility. Either the capability should exist to handle such a situation should it arise, or appropriate provisions should be made in the scheme, such as compensating only shortfalls of certain magnitude and no more.

In forecasting cost estimates for the liberalized IMF scheme, adjustments will have to be made for country coverage and the potential use of this facility. The estimates for the IMF scheme presented in this section covered 57 developing countries. These 57 countries accounted for approximately 55-60 percent of the non-oil exports of all developing countries as reported in the IFS for 1973. If we assume that total coverage of developing countries would increase the cost of the IMF scheme proportionately, the previous estimates must be adjusted upwards by 1.66.

Since the criteria for choosing the 57 countries endeavored to select poor countries with significant export instability problems, the 1.66 adjustment factor is probably too large since most of the excluded countries are richer developing countries with relatively diversified exports (e.g., Argentina, Mexico, Greece, and Israel).

Forecasts of cost estimates of an IMF scheme should also take into account the fact that eligible borrowing countries in the existing IMF scheme have not used the facility to the extent that they qualified on purely technical grounds. If the estimate of average annual drawings ($142 million) of the existing IMF facility (Table VII) is adjusted for country coverage (multiplied by 1.66) and compared to actual average annual drawings from the IMF facility over the same time period ($102 million), the results show that the use factor is 43 percent. The use factor was so small because either countries did not apply for loans, used other financing facilities , did not have trade data on time to verify there was a shortfall, or the IMF did not approve certain countries' requests. The 43 percent factor is probably an underestimation for forecasting purposes since countries may be expected to make greater use of a liberalized facility.

Given the degree of uncertainty involved in projecting the cost estimates prepared for the 1960's and early 1970's, any forecasts should be considered very tentative. Nevertheless, it is useful to obtain some indication of the effects of the various adjustment factors on

the cost estimates. For this purpose, the average annual drawing estimate for the liberalized-undeflated-IMF scheme ($306 million) will be used. If total non-oil exports from developing countries are assumed to grow at an annual rate of 12 percent from 1976 to 1980, the scale factor reflecting the increase in export value between the average value in the simulation period and 1976-1980 is 3.6. The developing country coverage adjustment factor is 1.66. Keeping in mind that both of these factors contain upward biases as previously mentioned, they increase the annual base figure of $306 million to $1.8 billion. Adjusting for the use factor of 43 percent (which is probably underestimated), the average annual drawing decreases to $770 million. To the extent that export instability decreases with time or with the value of exports, this figure may be reduced still further.

The results of applying these adjustment factors show that the costs of a scheme in the late 1970's could be substantially different from the costs estimated for the 57 countries in our sample in the 1960's and early 1970's. The relative costs of the various types of schemes estimated, however, should still be valid for comparison purposes for the future. Moreover, the absolute costs of the scheme can be controlled by safeguard measures or by adjustments in the terms of compensation or repayment.

C. Sources of Financing

One of the critical issues in setting up a multilateral compensatory financing scheme is determining the source of financing. The possibilities

depend on where and how such schemes are created. A number of options exist if it is decided that an expansion of the IMF facility is the most politically feasible way of increasing the financing resources available to developing countries suffering earning shortfalls. The IMF regular funds may be adequate to operate a liberalized facility. If these funds are not adequate, further contributions from the developed countries could be requested according to their IMF quotas or according to their market shares of developing countries' exports.

Direct contributions from developed countries might not be a realistic option with the recent experience of foreign aid programs. Another option is to sell part of the IMF gold holdings. This financing source will be more readily available if the funds are used to liberalize the existing facility in the IMF. Gold sales would in most instances not require appropriations from national legislatures and thus need not compete with other requests for aid appropriations. If use of the expanded IMF facility is restricted to developing countries, gold sales in the amount of $2 billion would probably be enough to finance the grants of the simulated liberalized scheme for the 1976-80 period. After making the adjustments for the scale and use factors, drawings were estimated to be around $770 million. The ratio of net to gross drawings in the simulations was approximately 50% (see Table VII). If the same ratio holds, net annual drawings would probably be between $350 and $400 million. During the initial two or three years of the operation of the fund, there will not be repayments, but when they begin, net drawings should be proportionately reduced. Needless to say,

this is a tentative estimate. The gold sales option should be analyzed within the broader question of whether this is the optimum use of these gold holdings. In addition, it is not at all clear that the gold market could absorb the sales of such large amounts of gold without its price falling drastically, reducing the profits made from such sales.

VII. Compensatory Financing Schemes as an Economic Aid Instrument

A. Economic Impact of Compensatory Financing Schemes

Whether a CFS draws on IMF funds or the contributions of developed countries through appropriations or gold sales, it necessarily must compete with other claims for these scarce international financial resources. It is important, therefore, to analyze the effectiveness of a CFS as an aid instrument. Since the effectiveness of a CFS cannot be judged precisely without defining the objectives and particular features of an individual scheme, the discussion below focuses on some general considerations which would tend to enhance or diminish the effectiveness of a CFS as an aid instrument.

A CFS should be judged in terms of its impact on the long-run development objectives of the recipient governments as well as on world wide resource allocation. The impact of a CFS within the recipient country consists of the increased availability of external resources and effects on long-run economic growth through the reallocation of resources.

The impact of a CFS on resource allocation basically depends on the use of the funds by the beneficiary country governments. Neither of the existing schemes, i.e., STABEX and the IMF facility, impose any constraints on the specific uses of the loan funds by the recipients. Loans from the IMF facility are conditioned only on

acceptable performance in broad macro-economic policy variables. The basic decision which developing countries must make is whether or not to use the loan funds to directly compensate commodity producers. Beneficiary governments are more likely to compensate producers' income losses in a CFS related to particular commodities, such as STABEX.

Loans from a CFS are beneficial to developing countries to the extent that an export earnings shortfall is not allowed to cause an unacceptable reduction of imports or any other actions which would seriously inhibit economic growth. When beneficiary governments do not compensate commodity producers, the funds can be used to pursue broad fiscal and monetary policies which help to maintain adequate import and investment levels. While these policies may have implications for resource allocation, it is impossible to determine a priori whether they will be beneficial or not.

Income shortfalls in some commodity sectors may cause such major disruptions in developing country economies that the governments find it necessary to compensate commodity producers. For example, the governments might want to finance additional farm inputs when bad weather destroys crop harvests. They might also use the proceeds of the loans to operate buffer stocks which would tend to stabilize long-term supply and prices both in domestic and international markets. When

financing buffer stocks, governments should ensure that producers or distributors have not already accumulated large private stockpiles when the export earnings shortfalls occur. Otherwise, producers or distributors who are automatically compensated might simply curtail operations and earn a windfall profit by selling to the buffer stock.

Complete compensation for income shortfalls sustained by producers is probably unwise. Producers might maximize output levels and ignore their collective impact on international market prices. Assuming inelastic demand conditions in commodity markets, complete compensation would tend to foster an oversupply situation and an eventual long-run downward trend in export earnings. Under such circumstances, rather than serving its intended purpose, a CFS might tend to exacerbate price and earnings fluctuations.

The policies that recipient governments pursue with respect to compensating producers are critical to the effectiveness of a CFS as an aid instrument. The elimination of short-run earnings fluctuations is meant to facilitate investment in the production of commodities with favorable long-run growth prospects. If governments compensate producers indiscriminately without considering the soundness of producers' investment and production strategies, it is likely that funds will be used inefficiently.

The effectiveness of a CFS as an aid instrument should also be judged in terms of its implications for world-wide resource allocation and trade. In cases where CFS funds are not used directly in the commodity sectors which primarily suffered the export earnings shortfalls, the impact in international commodity markets and on world wide resource allocation is difficult to gauge but is probably negligible since the amount of the

aggregate transfers are relatively small.

If there are commodity producers which are not participants in the CFS, they could still benefit from any price stability generated by the scheme. This indirect benefit might appear small, however, when compared with the availability of compensatory financing to beneficiary countries, especially since price stability is not necessarily a result of the operation of the scheme. It is also possible that non-participating producers could be damaged by the by the operation of the scheme through a deterioration of their market shares. Through the financing of buffer stocks, beneficiary countries could better weather low points in a commodity cycle and take greater advantage of subsequent booms. These could be important factors in determining market shares. If it is considered desirable that a CFS not affect market shares, this consideration suggests that even some developed countries producers of commodities should become beneficiary countries. However, on equity grounds it could be argued that a CFS should only be geared to developing countries which have less flexibility to adjust to fluctuations problems.

Consuming countries which participate in a CFS as donor countries would obviously benefit by any price and supply stability generated by the scheme. More stable commodity prices would make inventory control easier and less expensive for private firms. Inflationary tendencies created by commodity price fluctuations under

conditions of downward price rigidity are also avoided. The operations of a CFS, by helping to solve the export instability problems of developing countries, would also help to reduce the spirit of confrontation which has existed for a number of years in the commodity trade field. This more intangible benefit might prove to be quite important for consuming nations in their economic relations with the commodity producing developing countries.

B. Evaluation

Compensatory financing schemes have been designed to compensate for export earnings shortfalls which can seriously limit economic growth in developing countries. A CFS involves resource transfers designed to deal with this one problem in developing countries which hinders economic development. Its role as a foreign aid instrument is limited by the fact that it is only designed to help countries with export earnings instability problems.

To what extent a CFS is a good foreign aid instrument depends in part on whether the earnings instability has been caused by misguided domestic policies. If the instability is caused by misguided policies and a CFS compensates the earnings shortfalls of these countries, such an aid instrument may be rewarding or at the very least permiting the continuation of these policies. A CFS may tend to isolate these countries from developments in international markets which are partly the results of their own actions. This situation can be avoided by implementing a CFS with some discretionary provisions to make sure that the wrong policies are not rewarded. In addition by only compensating

shortfalls from a medium-term trend, a CFS can ensure that a downward export earnings trend is not compensated. With these mechanisms, a CFS can constitute a useful foreign aid instrument. If shortfalls are due to outside events, the financing of the shortfalls should help a country return to a stable economic growth path.

In the end the success of a CFS will crucially depend on the internal use of the funds in producing countries. The operations of a CFS could possibly be supplemented with some technical assistance programs to help determine the optimal use of the funds given the domestic producer situation and future market prospects.

A CFS as an economic aid instrument has also the attractiveness of considerable flexibility in differentiating beneficiary countries. In this study we have analyzed schemes which compensate for earnings shortfalls of low income countries on a grant basis. This is only one possibility of designing schemes so as to make them more responsive to international concerns about channeling concessional transfers to the poorest developing countries. There are other possibilities of implementing schemes with restrictive eligibility requirements and ways of measuring a shortfall which could make them more responsive to specific aid goals. However, it is clear that a CFS can only help to solve one particular problem that might arise in the course of development and cannot be viewed as a general instrument of support for all developing countries.

VIII. Summary and Conclusions

Recent events have combined to create an apparently opportune time for international cooperation in the area of commodity trade

stabilization. Developing countries have long been concerned with the problems of export price and earnings instability, while the interests of the developed countries have recently been aroused by the distruption related to commodity trade and access to critical raw materials in the early 1970's. This study has analyzed compensatory financing schemes through which developed countries could help to stabilize the export earnings of developing countries.

Once the case was made in general for a compensatory financing scheme, the more complex topics concerning actual operating arrangements and institutionalization issues were investigated. Decisions regarding these items often depend on the objectives of the scheme. For example, stabilizing total export earnings is appropriate if the objective is to assist developing countries with their periodic foreign exchange shortages, whereas stabilizing export earnings of major commodities may be appropriate for objectives more directly related to individual problem commodities.

Decisions regarding the terms of compensation and repayment depend partly on the degree to which one wants to differentiate in favor of the poorest developing countries. The simulations showed that substantial differentiation can be accomodated without excessive increases in costs.

It was concluded that for the purposes of a compensatory financing scheme the actual measurement of export earnings fluctuations is best accomplished with a moving average of years immediately adjacent to the year of concern. Although this procedure involves the problems of forecasting export earnings, it avoids compensating for downward trends. The

simulations showed that a multilateral scheme is preferable to a scheme with only one or a few donors. A multilateral scheme is more cost effective and also avoids the possiblility of creating trade blocs. For this latter reason, it is also preferable to include as many developing countries as possible in the scheme.

The empirical estimates of the costs and benefits of a compensatory financing scheme assuming it were in operation during the 1960's and early 1970's showed that the costs were manageable and that the benefits were fairly evenly distributed with the poorest countries accounting for significant shares. The costs and benefits did not differ greatly between the cases of five and four-year moving averages, nor between cases which stabilized different levels of aggregation of exports.

In discussing the possible ways of institutionalizing a compensatory financing scheme, simulations were performed for a liberalized IMF facility and the benefits from this scheme were fairly similar to the results of the OEDC schemes. An alternative scheme with OECD countries as donors might result in more benefits to developing countries by comparison to a liberalized IMF scheme due to the IMF quota limitations. On the other hand, the liberalized IMF facility might be preferred since it has the practical advantages of working through an established institution and not requiring additional budgetary contributions from the developed countries.

The extent to which a compensatory financing scheme can help developing countries with the problems associated with instability of export earnings depends in the end on how the funds are used by the beneficiary governments. There are aspects of the scheme which could be ineffective in achieving its goal and even detrimental if a government does not use the funds

for their intended purpose. If the funds are used for their intended purpose of stabilizing short-run fluctuations in export earnings, the CFS can be very useful both in relieving periodic foreign exchange constraints and in facilitating the diversification of the economy so that eventually a CFS will no longer be necessary.

Appendix I

Beneficiary Countries in the Compensatory Financing Scheme Study

AFRICA:
- Cameroon
- Central African Republic
- Chad
- Dahomey
- Egypt
- Ethiopia
- Ghana
- Guinea
- Ivory Coast
- Kenya
- Liberia
- Malagasy Republic
- Malawi
- Mali
- Mauritania
- Morocco
- Niger
- Senegal
- Sierra Leone
- Somalia
- Sudan
- Tanzania
- Togo
- Tunisia
- Uganda
- Upper Volta
- Zaire
- Zambia

ASIA:
- Afghanistan
- Burma
- India
- Indonesia
- Malaysia
- Pakistan-Bangladesh*
- Philippines
- Sri Lanka
- Syria
- Thailand
- Turkey
- Yemen

LATIN AMERICA:
- Bolivia
- Brazil
- Chile
- Colombia
- Costa Rica
- Dominican Republic
- Ecuador
- El Salvador
- Guatemala
- Guyana
- Haiti
- Honduras
- Jamaica
- Nicaragua
- Panama
- Paraguay
- Peru
- Uruguay

* The study covers a period during which Pakistan and Bangladesh were still one country. Some of the exports came from Bangladesh (jute exports) and others from Pakistan (cotton).

APPENDIX II

Commodity--Country List for the Compensatory Financing Scheme Project

SITC	Commodity	Country of Origin
011	fresh meat	Chad, Nicaragua, Paraguay, Uruguay
011.1	fresh bovine meat	
011.2	fresh sheep meat	
011.3	fresh swine meat	
012.1	bacon	
012.9	dried meat	
013.3	meat extracts	
013.4	sausages	
013.8	other prepared meat	
042.1	rice in the husk	Thailand, Burma
042.2	glazed rice	
044.0	maize	Thailand
051.1	oranges, tangerines	Morocco
051.2	other citrus fruit	
051.3	bananas	Costa Rica, Ecuador, Guatemala, Honduras, Panama, Somalia
051.7	coconuts	Philippines, Sri Lanka
061.1	sugar	Brazil, Dominican Republic, Guyana, Philippines, Haiti, Malagasy Republic
071.1	green or roasted coffee	Costa Rica, Brazil, Cameroon, Colombia, Dominican Republic, Ecuador, El Salvador, Ethiopia
071.3	coffee extracts	

SITC	Commodity	Country of Origin
		Guatemala Guinea Haiti Honduras Ivory Coast Kenya Malagasy Republic Nicaragua Sierra Leone Tanzania Togo Uganda Yemen
072.1	cocoa (rain)	Dahomey Ivory Coast
072.3	cocoa butter & cocoa paste	Cameroon Ghana Sierra Leone Togo
074.1	tea	India Kenya Pakistan-Bangladesh Sri Lanka
121.0	tobacco	Dominican Republic Malawi Turkey
211.1 211.2 211.4 211.6	bovine hides calf skins goat skins Sheep & Lamb skins	Ethiopia Somalia Uganda Upper Volta Uruguay Yemen
221.1	groundnuts	Senegal, Sudan Niger, Malawi, Mali
221.3	palm nuts and kernels	Dahomey
221.8	oil seeds	Ethiopia

SITC	COMMODITY	COUNTRY OF ORIGIN
231.1	rubber	Indonesia Malaysia Sri Lanka Thailand
242.1	pulpwood	Liberia Malaysia Paraguay Congo-Brazzaville Ivory Coast Honduras Cameroon Ghana Philippines
242.2	sawlogs and veneer logs	
242.3	sawlogs and veneer logs	
242.2	sawlogs and veneer logs	
242.3	sawlogs and veneer logs	
242.4	pitprops	
242.9	poles	
262.1	sheep's and lamb's wool	Uruguay
262.2	sheep's and lamb's wool	
262.3	fine animal hair	
262.5	horse hair	
262.6	wool shoddy	
262.7	wool or other animal hair	
262.8	wool tops	
262.9	waste of wool	
263.1	raw cotton	Nicaragua Afghanistan Bangladesh (Pakistan) Chad Central Africa Republic Dahomey Egypt El Salvador Guatemala Mali Paraguay Syria - Sudan Tanzania Turkey Uganda Upper Volta Yemen
263.2	cotton linters	
264.0	Jute	Pakistan-Bangladesh
265.4	Sisal	Tanzania

SITC	COMMODITY	COUNTRY OF ORIGIN
281.3	Iron ore and concentrates	India Liberia Mauritania Sierra Leone
283.3	bauxite and concentrates of aluminum	Guinea Guyana Haiti Jamaica
283.5	zinc	Bolivia
283.6	tin	Bolivia Zaire
283.7	manganese ore	India
421.5	olive oil	Tunisia
653.4	Jute fabrics, woven	India Pakistan-Bangladesh
682.1	unwrought copper & alloys, whether or not refined	Chile Mauritania Peru Uganda Zambia Zaire

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A.I.D. DISCUSSION PAPERS*

Date of Paper	Discussion Paper No.	Title and Author
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6/67	16	Unemployment in Less Developed Countries by Fred Dziadek
4/68	17	AID Administration to the Rural Sector, the JCRR Experience in Taiwan and its Application in Other Countries by Richard Lee Hough
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A.I.D. Discussion Paper No. 33

Production Characteristics in Foreign Enclave and Domestic Manufacturing: The Case of India

June 1976

Bureau for Program and Policy Coordination
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A.I.D. Discussion Paper No. 33

PRODUCTION CHARACTERISTICS IN FOREIGN ENCLAVE AND DOMESTIC MANUFACTURING: THE CASE OF INDIA

Danny M. Leipziger

June 1976

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Introduction

The issue of technology choice by foreign-owned manufacturing firms in less developed countries (LDCs) has received considerable attention from development economists.[1] Although empirical work has been limited, and results mixed, there is some evidence that foreign affiliates of multinational corporations (MNCs) select technologies which may not be as labor-intensive as economic theory would predict on the basis of factor endowments.[2]

The purpose of this paper is to compare the production characteristics of domestic Indian manufacturing firms with those of U.S.-owned manufacturing affiliates in India. This analysis allows us to examine the hypothesis that domestic firms are more responsive to the relatively lower wage-interest ratios prevailing in LDCs and that they therefore employ more labor-using technologies. Such an hypothesis is a logical extension of Reuber's /9/ finding that a higher degree of local equity participation or managerial control is associated with an increased probability that the firms choice of technology will reflect comparative factor costs. The converse hypothesis would support Strassman's /11/ finding; namely, that foreign firms are more responsive in adapting technology to local conditions than are local firms.

I. Methodology

We posit Cobb-Douglas production functions for the respective manufacturing sectors.

$$(1) \quad VA = AK_i^a L^b \; ; \; i=T,F,W$$

where VA = value added defined to include wages, pre-tax profits, interest, depreciation and net indirect taxes.

A = constant term

K_i = proxy for the flow of capital services

T = total capital assets

F = fixed capital assets

W = working capital defined to include inventories and cash

L = persons employed

a,b = respective output elasticities for capital and labor.

The production functions are estimated in logarithmic form for a matching sample of Indian-owned and U.S.-owned manufacturing firms. By matching sample, we mean that the Indian firm data is adjusted so that it corresponds to the industrial breakdown of the U.S. manufacturing sample in terms of the value added accounted for by each two digit industry. Therefore, we are comparing the technology employed by U.S. firms to produce a bundle of output in India vis-à-vis the technology that would have to be employed by Indian firms to produce the same bundle. If the estimated coefficients of the respective equations are shown to be statistically different using Chow's /1/ test, then we calculate the average capital-labor ratio resulting from the least-cost tangency of an isoquant and the factor-price constraint. We distinguish between diverse capital-labor ratios resulting from disparate technologies (i.e. production functions)

and diverse capital-labor ratios resulting from different factor price relations. In other words, we believe in both ex ante and ex post substitution, where a particular technology (e.g. plant design and machinery) is employed, yet where substitution possibilities exist between labor and capital in sub-processes or peripheral operations of the plant.[3] In Figure 1 therefore, an isoquant estimated for sample data depicts a particular technology (rather than a shelf of technologies) and the elasticity of substitution is assumed to be positive.

In Figure 1, k^{US} and k^{I} can be viewed as the average observed capital-labor ratio which U.S. and Indian firms have selected when facing their respective wage-interest relations. Assuming that the U.S. firm were confronted with the same wage-interest ratio facing the Indian firm, however, it would choose k^{US*} as its optimal capital intensity.[4]

We therefore are interested in the following analyses: a) comparing the production functions utilized by the U.S.-owned and Indian-owned manufacturing firms i.e., isoquant I versus isoquant US on Figure 1; b) if the production functions differ, comparing the technology differences which cause capital intensities to differ given equal factor price relations facing all firms i.e., compare k^{I} and k^{US*}; and c) comparing the actual observed capital intensities given diverse factor prices i.e., k^{I} and k^{US}.

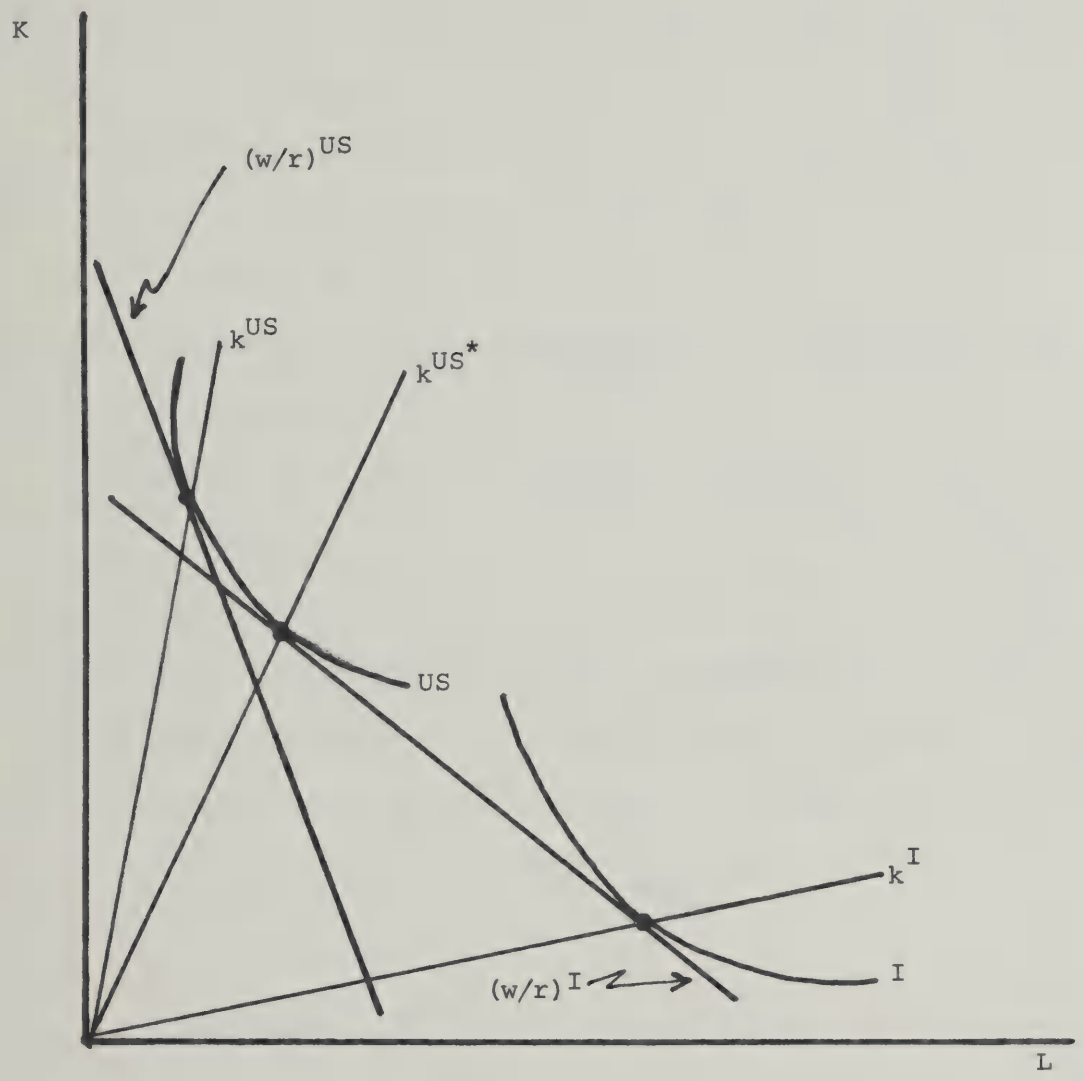
II. The Data

The Indian firm data as of 1964-65 is reported in the United Nations Industrial Development Organization's Profiles of Manufacturing Establishments and it includes fixed capital assets after depreciation (K_F) and

working capital (K_F) which sum to total capital assets (K_W) which sum to total capital assets (K_T); employment in terms of men on the payroll (L); and value added (VA). The 80 firms included are primarily single-establishment firms, with a few branch observations being aggregated into single data points. The data was converted to dollars at then current exchange rates. Comparable data for Indian affiliates of U.S. MNCs was reported for 1966 in the U.S. Commerce Department's Special Survey.

In order to compare the production characteristics of the U.S.-owned and Indian-owned manufacturing samples, adjustments are required to compensate for the fact that the industrial breakdown of the U.S. enclave is different from that of the domestic manufacturing sample. Therefore, while we first estimated production functions for domestic Indian manufacturing, we then proceeded to re-estimate the equations weighting the observations to match the industrial breakdown weights in the U.S. subset. In other words, if chemicals accounted for 25% of total value added in the U.S. subset, we reweighted the domestically-owned set so that chemicals account for 25% of total value added in domestic manufacturing. The effect of this adjustment is to compare the production characteristics of U.S.-owned firms producing a certain bundle of manufactures with the production characteristics which Indian firms would have exhibited, were they to produce the very same bundle in terms of a two-digit industrial breakdown.[5] The data on individual

Figure 1: Heuristic Presentation



Indian firms is then adjusted correspondingly with equal changes in a firm's labor, capital, and value added; the weighted variables are subset, we reweighted the domestically-owned set so that chemicals account for 25% of total value added in domestic manufacturing. The effect of this adjustment is to compare the production characteristics of U.S.-owned firms producing a certain bundle of manufacturers with the production characteristics which Indian firms would have exhibited, were they to produce the very same bundle in terms of a two-digit industrial breakdown.[5] The data on individual Indian firms is then adjusted correspondingly with equal changes in a firm's labor, capital, and value added; the weighted variables are denoted by L*, K_T^*, K_T^*, and VA*.[6]

III. Results

Ordinary least-squares regressions are reported for the Cobb-Douglas production functions, estimated for a sample of 80 domestic firms, utilizing three alternative measures of capital services.

(2) $\log VA = .037 + \underset{(5.59)}{.540} \log K_F + \underset{(2.45)}{.316} \log L$

$\bar{R}^2 = .72$
$n = 80$

(3) $\log VA = .358 + \underset{(4.07)}{.460} \log K_W + \underset{(2.96)}{.425} \log L$

$\bar{R}^2 = .67$
$n = 80$

(4) $\log VA = -.716 + .572 \underset{(4.97)}{\log K} + .302 \underset{T(2.09)}{\log L}$

$\bar{R}^2 = .70$
$n = 80$

Unless noted all parameter estimates are significant at the 1% level. T statistics are reported in parentheses; $\bar{R}^2$ is the adjusted coefficient of determination; n is the number of observations. Testing of returns to scale indicates that equations using working capital and total capital exhibit constant returns to scale at the 1% level. In the case of fixed capital, the equations exhibit constant returns to scale at a 5% level of significance and decreasing returns to scale at a 1% level of significance.[7]

Adjusting the data to reflect the industrial distribution of two-digit manufacturing firms in the U.S.-owned sample of establishments, we obtain equations (5-7). SSR is the sum of squared residuals.

(5) $\log VA^* = -124 + .460 \underset{(5.11)}{\log K^*} + .460 \underset{F(4.29)}{\log L^*}$

$\bar{R}^2 = .79$
$n = 80$
$SSR = 10.65$

(6) $\log VA^* = -.426 + .384 \underset{(3.40)}{\log K^*} + 537 \underset{W(4.24)}{\log L^*}$

$\bar{R}^2 = .68$
$n = 80$
$SSR = 12.43$

(7) $\log VA^* = .817 + .579 \log K^*_T + .411 \log L^*$
(4.45) (3.21)

$\bar{R}^2 = .71$
$n = 80$
$SSR = 18.47$

It is interesting to note that the average capital intensity for the adjusted Indian data is higher than for the unadjusted data, reflecting the higher capital intensity of the U.S. bundle of output. This finding is interesting from the viewpoint of comparative advantage and a composition analysis of manufacturing; it indicates that indigenous firms in the aggregate either seem to be concentrating in industries requiring less capital per worker or the indigenous technology, ex post, is less capital intensive regardless of the industrial breakdown.

The production function estimates for the U.S. sample are reported in equations (8-10).

(8) $\log VA = 1.597 + .244 \log K^*_F + .623 \log L$
(2.08) (5.30)

$\bar{R}^2 = .61$
$n = 49$
$SSR = 6.83$

(9) $\log VA = -.823 + .948 \log K_W + .223 \log L$
(6.21) (1.93)

$\bar{R}^2 = .77$
$n = 49$
$SSR = 4.11$

$$\log VA = 1.226 + .740 \log K + .334 \log L \quad (10)$$
$$(4.79) \qquad T(2.71)$$

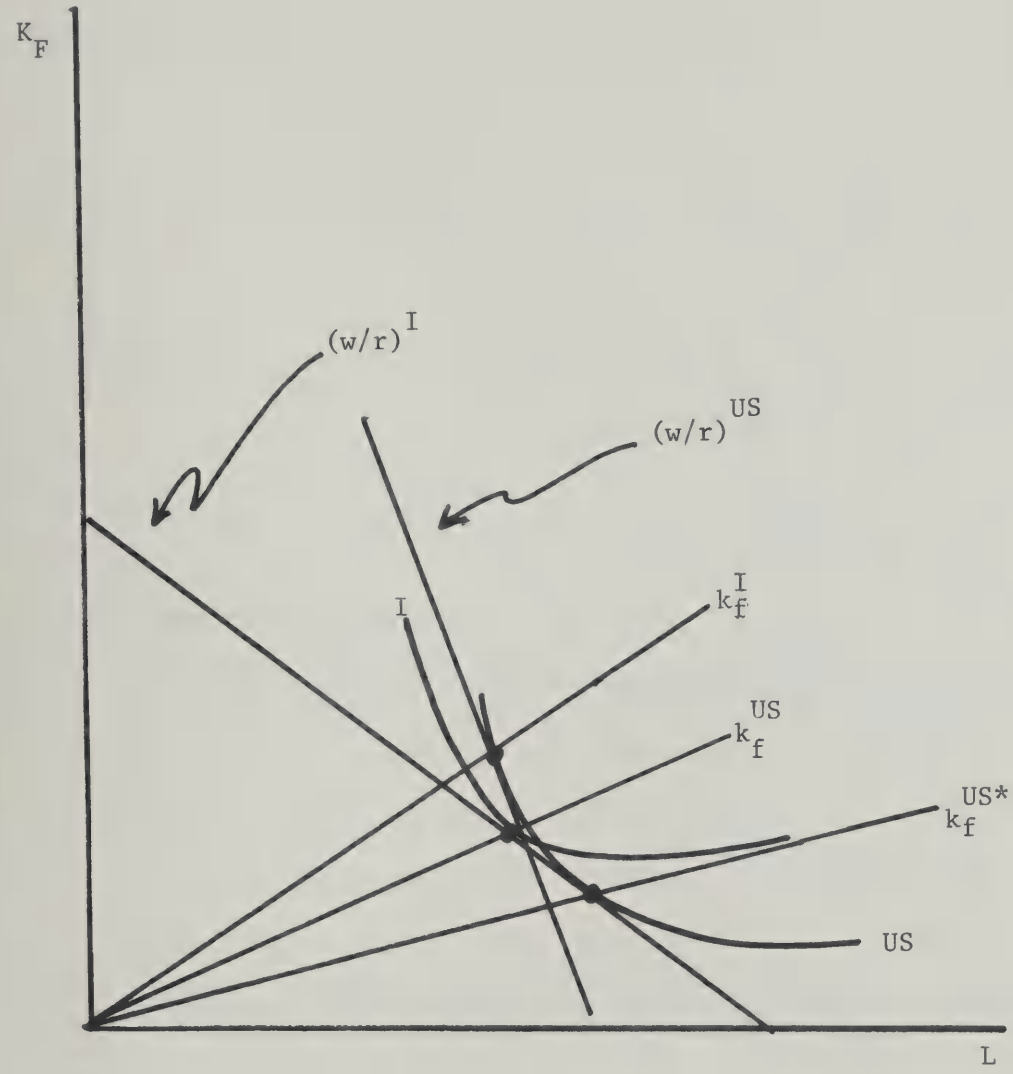
$$\bar{R}^2 = .72$$
$$n = 49$$
$$SSR = 5.04$$

The Chow test F-ratios indicate that the estimated equations for U.S. firms utilizing fixed and working capital, (8) and (9), are significantly different from equations estimated for Indian firms, (5) and (6), at a 1% level of significance. The estimated equations using total capital assets, (7) and (10), are not significantly diverse for the two samples, since differences in the productivity of working and fixed capital are being aggregated.

Since the respective samples exhibit diverse production functions in the cases of fixed and working capital, let us examine these differences more closely. Let k_f^{US} be defined as the observed averaged fixed capital-labor ratio for U.S. firms and k_f^I be defined as a similar variable for Indian-owned firms. A comparison of observed means, k_f^{US}/k_f^I yields a value of 1.296, indicating that U.S. firms employ more fixed capital per man than do Indian firms.

When we adjust the capital-intensity of the U.S.-owned firms to reflect the tangency of the U.S. firms' isoquant and the Indian firms' wage-interest constraint, we can recalculate k_f^{US}/k_f^I equal to .391. This can be interpreted as follows: the technology of U.S. firms is inherently less capital intensive than that of the Indian firms in terms of fixed plant and equipment. In Figure 2, therefore, when facing

Figure 2: Actual Configuration



a similar set of factor prices, the U.S. isoquant tangency occurs at an average fixed capital to labor ratio below that of Indian isoquant. When the constraint of equal relative factor prices is relaxed, however, and observed capital-intensities are examined, U.S. firms tend to exhibit more capital-intensive operations. These findings are consistent with the view that U.S. firms face higher wage-interest ratios and therefore, are encouraged to select a capital-labor mix biased towards capital use.[8] U.S. firms may face higher wage-interest relations as they: (1) may receive direct or indirect interest subsidies from LDC governments which stimulate the use of capital; (2) have greater access to internal capital from multinational parent companies at lower real interest rates; and (3) face perhaps stiffer union pressure than domestic firms, which raises relative wages.

In terms of working capital--inventories, cash, and input stocks--a similarly defined ratio k_w^{US}/k_w^{I} of .758 can be calculated. Thus, the average observed working capital to labor ratio for U.S. firms is <u>less</u> than the similar measure for Indian firms, perhaps due to management differences or a higher opportunity cost of capital for U.S. firms. The U.S. sample's output elasticity of working capital is significantly above that for the Indian firms; so that although the average holdings or working capital are low, its productivity is high.

IV. Summary

We estimate Cobb-Douglas production functions for U.S.-owned and Indian-owned manufacturing affiliates.[9] We discover that U.S.

firms in our sample of manufacturing affiliates employ a less capital-intensive technology but a higher fixed capital intensity than Indian firms. Abstracting from possible differences in the age of capital between samples, the inference is that the technology imported by or developed for Indian firms would be more capital-using to produce the same bundle of output produced by the U.S.-owned firms. We also find that U.S. firms in India face a higher wage-interest ratio than domestic firms and thus adjust the ex ante technology, so that on average they utilize more fixed capital per man ex post than counterpart Indian firms.

FOOTNOTES

1/ See for example Cohen, Hymer, Leff, Mason, Pack, Pickett, Reuber, Strassman, Wells, and Winston.

2/ See Courtney and Leipziger

3/ See Winston.

4/ k^{US*} is derived as follows:

(1) $$\frac{a}{b} = \frac{\frac{\partial V}{\partial K}\left(\frac{K}{V}\right)}{\frac{\partial V}{\partial L}\left(\frac{L}{V}\right)}$$

definition of relative output elasticities, where $\partial V/\partial K$ and $\partial V/\partial L$ are the respective marginal products of capital and labor.

(2) $$\frac{\frac{\partial V}{\partial K}}{\frac{\partial V}{\partial L}} = \frac{r}{w}$$

optimality in production requires the relative marginal products to equal the relative factor prices (e.g. isoquant, factor-price tangency).

(3) $$\frac{K}{L} = \frac{a}{b}\left(\frac{w}{r}\right)$$

(4) $$k^{US} = \frac{a^{US}}{b^{US}}\left(\frac{w}{r}\right)^{US}$$

$$(5) \qquad k^I = \frac{a^I}{b^I} \left(\frac{w}{r} \right)^I$$

$$(6) \qquad \text{let } (w/r)^{US} = (w/r)^I$$

$$(7) \qquad k^{US*} = k^I \left(\frac{a^{US}}{b^{US}} \frac{b^I}{a^I} \right)$$

5/ The very same results obtain if the U.S. sample is reweighted to match the Indian industrial breakdown.

6/ This scaling procedure is less accurate, the more the Cobb-Douglas diverges from constant returns to scale.

7/ To test whether or not constant returns to scale do obtain, we take the logarithmic form of (1) and obtain (8) by simple manipulation.

$$(8) \qquad \text{In } VA/L = \text{ln } A + a \text{ ln } K/L + (a+b-1) \text{ ln } L + e$$

If the coefficient of ln L is not significantly different from zero, then constant returns to scale do prevail - namely, a + b = 1.

Equations 13-15 test for constant returns to scale for 80 domestically - owned manufacturing firms:

$$(9) \qquad \text{ln } VA/L = -.037 + \underset{(5.59)}{.540} \text{ ln } K_F/L - \underset{(-2.01)}{.144} \text{ ln } L$$

$$(10) \qquad \text{ln } VA/L = -.716 + \underset{(4.97)}{.572} \text{ ln } K_W/L - \underset{(-1.72)}{.125} \text{ ln } L$$

$$(11) \qquad \text{ln } VA/L + 1358 + \underset{(4.07)}{.460} \text{ ln } K_T/L - \underset{(4.50)}{.114} \text{ ln } L$$

8/ The calculated $(w/r)^{I}$, where w is yearly wage per worker and r is net return to capital, is .43, while $(w/r)^{US}$ is .78.

9/ Sankar finds that Cobb-Douglas functions cannot be rejected in any Indian manufacturing industry except one in his 1950's sample; however, he does find increasing returns to scale in some industries.

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A.I.D. Discussion Paper No. 34

The Effects of Distortions in the Factor Market:
Some General Equilibrium Estimates

July 1976

Bureau for Program and Policy Coordination
Agency for International Development

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THE EFFECTS OF DISTORTIONS IN THE FACTOR MARKET: SOME GENERAL EQUILIBRIUM ESTIMATES*

by

JAIME DE MELO

Agency for International Development
Bureau for Program and Policy Coordination

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THE EFFECTS OF DISTORTIONS IN THE FACTOR MARKET: SOME GENERAL EQUILIBRIUM ESTIMATES

I. INTRODUCTION

For a perfectly competitive economy with no monopoly power in trade, laissez-faire is Pareto optimal as the economy will operate with technical efficiency (i.e., it will be on the "best" transformation surface). Under these circumstances, the first order conditions for an economic maximum will hold for any pair of commodities: DRT=FRT=DRS (where DRT represents the marginal rate of transformation in domestic production, FRT represents the marginal foreign rate of transformation and DRS represents the marginal rate of substitution in consumption). Until recently, economists have usually assumed that rates of return to each factor are equalized across occupations so that the allocation of resources is technically efficient, and they have concentrated on the effects of monopoly power and distortions in product markets (FRT$\neq$ DRT=DRS). However, during the last two decades several studies have investigated the welfare effects of distortions in the factor market.[1/] These studies, usually conducted within the context of a two factor, two commodity model, have shown that distortions in the factor

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1/ Among others, the following papers examine the welfare effects of distortions (including distortions in the factor market) and the policies that should be applied to increase welfare: Fishlow and David (1961), Bhagwati and Ramaswami (1963), Johnson (1966), Bhagwati (1971), Herberg and Kemp (1971). An excellent survey of the literature is given in Magee (1973).

market lead to a loss of economic efficiency (because the community's output is inside the non-distorted transformation curve), and that the "first best" policy to correct factor market distortions is a tax-cum-subsidy policy on factor use. Some of these analyses have also emphasized the theoretical possibility that factor market distortions may lead to physical and/or value factor intensity reversals, thereby causing a breakdown of the Samuelson factor price equalization theorem.

In general, these studies deal exclusively with the theoretical aspects of distortions. On the empirical side, it is often asserted that the established equilibria are close to a Pareto optimum and welfare losses are of a second order of magnitude.
Only a few studies have attempted to estimate the magnitude of these welfare losses caused by distortions in the factor market. These estimates have usually measured losses from monopoly power in trade and product price distortions (See summary by Leibenstein, 1966). For developing countries, Harberger (1959) estimated that the total cost of product and factor market distortions in the Chilean economy could sum up to fifteen percent of GNP. Balassa (1971) and Bergsman (1975), using a modified but similar methodology, found that for a sample of developing countries the static costs of factor misallocation did not exceed 2.4% of GNP.

Two recent studies by Dougherty and Selowsky (1972) (hereafter referred to as D-S) on Colombia and Floystad (1975) on Norway have attempted to measure explicitly the production costs of imperfections in the factor market in the form of wage differentials across sectors.

Their methodology consists of specifying sectoral production functions for primary factors for a number of sectors and solving the supply side of the system under different assumptions keeping product and factor prices fixed. The fixed-price assumption implies either that the economy is small and completely open (without non-traded goods) or that sectoral output changes are sufficiently small so as to leave relative product prices unchanged. The authors' estimates of the cost of factor market distortions are obtained by comparing actual observed sectoral outputs with those obtained under the optimal solution when the selected factors of production get equal returns across sectors.

The purpose of this paper is: (1) to go beyond this methodology by presenting a computable wage and price endogenous (WPE) general equilibrium model of resource allocation where both product and factor prices are allowed to adjust to changes in factor market distortions and; (2) to present some results for Colombia which may be compared to those by D-S. The remainder of this paper is organized as follows: section II presents the basic framework of the model specified in the appendix; section III outlines the data requirements; section IV reports the empirical results; and finally section V contains some concluding remarks.

II. FRAMEWORK

This section describes briefly the approach used to study the effects of factor market distortions on welfare and economic structure.

An important feature of the model is that it determines wages and prices endogenously. Johansen (1964) formulated the first empirical price-endogenous model. His model and that of Taylor-Black (1974) were linear in growth rates, and so could be solved as a set of simultaneous linear equations. The Walrasian approach, which is used here, involves directly solving for a set of market clearing prices and wages for a specified market behavior.

Before focussing on factor markets, the demand and supply sides of the economy will be presented briefly; the reader is referred to the appendix for a summary description of the complete model in equation form. Goods are classified into two categories: non-traded goods, whose prices are endogenously determined, and competitively traded goods. Goods which are imported but not processed domestically are lumped into a non-competitive import sector. Prices for traded goods are determined in world markets.[2/] There is one consumer who maximizes a Stone-Geary utility function yielding the linear expenditure system to represent private final demand. Investment and government demand are exogenously determined and fixed in base year prices. In this model,

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2/ There is one sector (coffee), however, which faces a quota on the world market. For that sector the export tax varies so as to insure that coffee producers supply the quantity fixed by their quota share in world supply. Although the model was originally designed to include both factor and product market distortions, this paper will be restricted to estimating the effects of removing the differentials in factor markets leaving product market distortions at their existing levels. See de Melo (1975) for a discussion of the welfare effects of these distortions and a full description of the model. See Adelman-Robinson (1975) for a comparison of the programming and Walrasian approaches to specify price endogenous models.

all wages and prices (with the exception of those fixed by the small country assumption) are endogenously determined along with sectoral factor stocks and all quantities produced and traded.

On the supply side, producers maximize profits. A dual technological structure is specified: intermediate inputs enter in fixed proportions, but primary factors respond to changes in factor prices. Primary factors include capital and two types of labor employed by all sectors, and land which is used in the agricultural sectors only. Technology is described by two kinds of production functions: Cobb-Douglas and two-level C.E.S. Their equations are given in the appendix along with the respective factor demand equations.

Decreasing returns to scale are assumed for traded sectors. The economic justification for rising supply costs in import substitution industries follows Ifzal's (1975) study of import substitution in India. Owing to the high level of aggregation common in multi-sector models, sectoral production functions are used as proxies for all industries included in a sector, thereby losing information about the relative comparative advantage of industries within the sector. Defining, for each of these industries, their average cost as the domestic factor cost needed to save one unit of foreign exchange, one can derive the sector's stepped supply curve by ranking industries according to their cost.[3/] Taking a concrete example, the cost of replacing a dollar's

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3/ This argument is also followed by Chenery-Raduchel (1971, p. 34) although they introduced the assumption of rising supply costs on the demand side. See their import demand function (2.8).

worth of, say, metal products varies according to the particular commodity produced. An expansion (contraction) involves moving up (down) the steps on the curve to a successively higher (lower) cost industry. Ifzal (1975) has derived the relation between cost, efficiency, and output using a neo-classical production function. On the export side, it is argued that increasing exports involve market development (or transport) costs. This assumption helps overcoming the specialization problem found in general equilibrium analysis when there are more product prices fixed through trade than variable factor prices.[4/]

Finally, two alternative assumptions are made with respect to factor mobility: (1) sectoral capital stocks remain fixed; and (2) all factors of production with the exception of land are mobile across sectors. This completes the description of the demand and supply sides of the model.

Two types of factor price differentials can be distinguished. First, factor prices may be the same in all industries but a differential may exist between real factor rewards and their marginal products in one or more industries. Second, real factor rewards may equal their respective marginal products in each industry but there may be a differential between the price of an identical factor in different industries. The differentials incorporated in the model presented here reflect the latter.[5/]

[4/] See Samuelson (1953). Virtually all multi-sector trade models assume decreasing returns to scale or fix quantities traded.

[5/] See Magee (1973, p. 2) for a list of causes which might give rise to this kind of differential. In his review, Magee distinguishes between distortions and differentials. For the purpose of this empirical analysis, both terms will be used interchangeably. See Bhagwati (1971) for a discussion of endogenous, autonomous, and policy imposed differentials.

In addition to the differential wage rates across sectors (eqs. 3 in the appendix), it is assumed that the differential wage per factor between the agricultural sectors and the rest of the economy remains fixed at its existing ratio in the base period (eqs. 4). In segmented dualistic economies such as Colombia, it is justifiable to assume that the dual wage structure between rural and urban sectors would persist after a removal of distortions in the urban sector. Therefore, although migration in response to increased demand pressures is incorporated in the model, the rural sector is not directly affected by a change in urban wages in urban wages so that the empirical estimates reported below are more directly comparable to previous ones, yet more comprehensive because a general equilibrium model is used.

The empirical experiments reported below consist of removing the differentials observed in the labor market by equalizing the wage rates for skilled and unskilled labor in the urban sectors while maintaining a constant rural-urban wage differential.[6/]

III. THE DATA REQUIREMENTS FOR THE COLOMBIAN EXPERIMENTS

The experiments with the model are based on Colombian data for 1969. Of the 15 sectors included in the model and described in Table 1, sectors 1 to 11 are classified as tradeable and sectors 12 to 15 as non-tradeable. This choice of aggregation was dictated by the input-output

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6/ Because of the distortions remaining in the capital market these experiments may not necessarily increase welfare.

information available for Colombia which does not distinguish between commerce, professional services, and artisans. Unlike the above mentioned studies, this model covers the whole economy, thereby including the agricultural sector which is disaggregated further into coffee and into other agriculture to take into account the fact that Colombia has a quota for coffee exports determined by the International Coffee Agreement.

Although this study follows a similar strategy concerning the valuation and treatment of wage differentials, the level of factor market aggregation is different in that it is more detailed than Floystad who only considers one category of labor, and less detailed than D-S who distinguish between seven skill classes of labor (but no capital since it is fixed) ranked according to educational levels. Here again the available data did not allow for a greater level of skill differentiation at this level of disaggregation. A brief discussion of the essential data requirements is reported in the appendix. It is important to note that with the introduction of factor wage differentials and the determination of the constants in the production functions (see appendix), the model reproduces the base year. Therefore it becomes possible to compare the actual allocations of resources with those which would prevail in the absence of factor market distortions.

Table 1 describes the return to labor and capital in Colombia in 1969 along with the sectoral breakdown of the economy. The sign entered next to sector names indicates whether that sector is a net exporter (+) or a net importer (-) Multiplying column 2 by column 1 would yield sectoral value added in thousands of current 1969 pesos. The rate of return to capital shown in column 3 differs greatly across sectors ranging from 7.6% in agriculture to 45.6% in light domestic industries.

Table I

ACTUAL WAGES AND EMPLOYMENT OF CAPITAL AND LABOR BY SECTOR, 1964

SECTOR	Gross Output Thousands of Pesos	Value-added (%)	Return on Capital (%)	Unskilled Wage: Pesos Per Man Year	Skilled Wage: Pesos Per Man Year	Capital Stocks Thousands of Pesos	Unskilled Labor Thousand Man Years	Skilled Labor Thousand Man Years
Coffee (+)	548.6	97.2	080	370	1,080	1,206.1	470.0	32.1
Agriculture (+)	2,963.6	842	07.6	410	1,210	7,477.8	1,979.1	132.7
Food, Beverage, Tobaco (+)	1,403.4	321	249	1,850	3,730	1,092.7	42.5	14.5
Textiles and Apparel (+)	817.8	464	161	1,660	3,460	1,078.1	73.9	13.1
Paper, Wood, Leather (-)	310.2	412	159	1,850	4,160	380.8	18.6	4.7
Rubber and Chemicals (-)	662.5	631	301	2,660	6,070	823.2	20.8	12.1
Metals and Products (-)	443.4	370	147	1,820	3,460	552.3	25.1	5.9
NonMetallic Products (+)	196.8	502	094	1,660	3,230	422.2	21.6	4.1
Mining and Petroleum (+)	482.4	632	128	800	4,440	1,349.9	76.3	2.4
Machinery (-)	218.0	599	227	2,560	4,780	252.5	14.1	5.0
Diverse Industries (-)	241.2	574	223	1,980	3,010	282.7	22.2	5.7
Light Domestic Ind.	507.6	549	456	3,920	7,100	400.4	13.6	5.9
Construction	1,113.0	675	084	1,470	15,750	2,014.9	318.5	7.2
Transport and Commun.	1,166.6	714	131	1,320	15,020	3,261.6	217.6	8.0
Services and Artisans	3,749.4	914	180	570	3,360	7,313.1	1,884.5	306.1
Column	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)

This set of figures is probably the most unreliable among the data presented in this table, since it is derived from the shaky estimates of capital stocks in column 6 and the exponents in the sectoral production functions. Columns 4 and 5 show the average wage per worker per year for unskilled and skilled labor. As expected, the nominal wages per worker are well below average for agriculture and coffee sectors where there must be a fair amount of payment in kind not captured in these figures, which, however, do attempt to correct for imputed income to non-paid workers. For the service and artisan sectors, which also indicate wages below the economy average, (640 pesos per unskilled worker, 3,000 pesos per skilled worker and 15.1% for the average return to capital) this may be expected since there is no unionization or foreign ownership which would tend to raise wage rates.

IV. THE EMPIRICAL RESULTS

Because it is difficult to have confidence in the estimates of distortions in the capital market, the experiments will be limited to removing distortions in the labor market, except for the rural-urban differential. Therefore, when capital mobility is allowed, it is assumed that the structure of differential rates of return across sectors reflects differences in risk or that they are temporary and due to adjustment costs. On the other hand, when capital stocks are fixed, it is assumed that the capital stock in each industry is exogenously given to the industry because investment decisions are made by the planning authorities. This means that the sectoral rates of return to capital are calculated from the equations determining the sectoral demands for capital (eq. 4 and 4' in the appendix). Therefore, in common with the

other studies, no attempt is made at removing distortions in the shares of wages and capital income.

While the model outlined in section II is capable of portraying a number of clearing principles for labor markets and for commodity markets, as well as a wide range of experiments, only a few experiments relating to the removal of differentials in the labor market are reported here. Following is the list of experiments:

A-1	Remove differentials in the unskilled labor market keeping capital stocks fixed.
A-2	Remove differentials in the skilled labor market keeping capital stocks fixed.
A-3	Remove differentials in both labor markets keeping capital stocks fixed.
B-1	Same as A-1 but, in addition, allow capital to be mobile across sectors.
B-2	Same as A-2 but, in addition, allow capital stocks to be mobile across sectors.
B-3	Same as A-3 but, in addition, allow capital stocks to be mobile across sectors.

Removing distortions in the urban sector is accomplished by setting all the differentials ($d_K^i = 1$, $i = 3 \ldots 15$ in eq. 3) equal to unity, recalculating the differentials for the agricultural sectors so as to maintain a constant rural-urban wage differential, and solving the model under the new market structure.

1) Welfare Effects

Table 2 summarizes the results of these experiments and provides comprehensive estimates of the welfare gains from removing

distortions in the labor market. These estimates differ from those offered so far in the literature in several respects. First, they are estimated in a general equilibrium framework where the presence of substitution in both demand and supply allows for an interaction between tastes and technology so that for commodities whose prices are not determined in world markets, a change in production cost will affect quantities supplied which in turn leads to a price adjustment to clear those markets. As will soon become evident, the price adjustments neglected by Floystad and D-S are likely to be significant (at least in Colombia). Second, and perhaps more important, these estimates are undertaken in a framework which recognizes that factor market distortions not only affect production, but also trade and therefore comparative advantage. With quantities traded endogenously determined, the model takes into account this important effect of factor market distortions, and as a by-product, the exchange rate adjustment required to maintain balance-of-payments equilibrium emerges from the solution of the model.

Before discussing the results in Table 2 it is useful to recall that these estimates, in common with others presented so far, refer not only to distortions which have normative or welfare implications but also to differentials reflecting age and education among workers, regional differences due to geographic concentration of low wage low skill industries, or efficiency differentials between sectors. Thus, as Magee points out, a differential is a necessary but not a sufficient condition for a distortion.[7/] Although the terms differentials and distortions

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7/ See Magee (1973, p. 2). It is surprising that the other empirical studies do not indicate the possibility that their measures may include differentials which are not a source of welfare distortion.

Table 2

EFFECTS OF REMOVING URBAN LABOUR MARKET DISTORTIONS
(all figures represent % changes)

Experiment	A-1	A-2	A-3	B-1	B-2	B-3
Welfare	1.0	0.2	1.3	0.6	0.8	1.3
GNP[1]	2.4	0.0	2.7	7.8	2.5	10.7
GNP[2]	3.9	0.0	5.7	9.2	2.8	13.3
Average unskilled wage	35.4	2.7	34.6	37.6	1.7	37.0
Average urban wage	-0.5	-0.3	-0.1	1.1	0.0	1.4
Average skilled wage	9.5	36.4	44.0	12.7	39.4	52.8
Average urban wage	6.2	1.8	7.8	9.6	4.1	13.8
Rate of return to capital	0.4	0.0	0.4	3.9	0.0	3.6
Exchange rate Devaluation (+)	-5.7	+1.0	-5.5	-5.7	0.0	-6.0
Coffee tax[3] rate (%)	38.4	44.4	38.6	40.6	43.4	39.9

Wage rates are per worker.
1. GNP valued using current prices as weights.
2. GNP valued using base prices as weights.
3. The coffee tax rate is 44% prior to removal of distortions.

are used interchangeably, one should be aware of the potential range of effects captured by these measures.

Because exogenous demand which includes investment (which equals savings ex post) remains fixed, the welfare effects of a removal of distortions are measured by the utility indicator. This is so because the total economic loss from factor market distortions can only be evaluated by taking into account, in addition to the inefficiency of production, the distortion of consumer choices due to the factor market distortion in producing a divergence of private from social opportunity costs in consumption.[8] The results in row one indicate that the welfare gains from removing the differentials are quite sensitive to both the assumptions concerning capital mobility and the factor market(s) in which the distortions are removed. Understandably, the welfare gains are larger if the differentials are removed in both labor markets; they are relatively smaller when distortions are removed in the skilled labor market. It is notable that fixing the rural urban factor wage differential has an important effect on the welfare gains resulting from a removal of distortions in the unskilled labor market. When capital stocks are fixed, there is no rising supply price of capital from agriculture to industry, which exerts a dampening effect on the welfare gains.

Rows 2 and 3 present estimates of the costs of labor market distortions in terms of GNP, valued both at base prices and at current prices. By inspecting these two sets of GNP estimates, one can get an estimate of the importance of the index number problem in assessing the performance of partial equilibrium estimates which assume that prices remain fixed.

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[8] Johnson (1966 p. 697).

The range of estimates is understandably quite large, as the efficiency gains from an elimination of wage differentials are influenced by the magnitude of these differentials. It is interesting to note that the efficiency gains in case A-3 show an increase in GNP of 5.7% valued at base prices. This gain is well above the estimates of D-S who note that "...the insensitivity of the level of output to the allocation of labor implies that the static first order conditions are of little relevance."9/ With an elasticity of substitution of 1.1 between different types of labor, they find that output would only rise by 0.48%. Although their experiments refer to an earlier year, and although it is likely that their estimates are lower partly because they have a greater number of factors of production resulting in employment changes tending to offset one another, it is likely that the difference in magnitudes between the two sets of estimates is due to the differences in methodologies and to the fact that these estimates allow for a migration of factors outside of agriculture while theirs do not.

Because the general equilibrium model describing the economy can only determine relative prices, one can impose some normalization rule on wages and prices. In comparing relative prices, it is convenient to maintain a constant price level, thereby implying that monetary authorities control the money supply during the resource shifts between sectors. This rule is followed in the price normalization equation (6) in the appendix.

9/ Dougherty and Selowsky (1972, p. 389).

It is notable that the GNP measures are quite sensitive to the choice of weights. However, the difference in the estimates is mainly accounted for by the required variation in the coffee tax rate (bottom row of Table 2) to maintain the quota share in the world markets. It can be seen that the divergence between the two measures is usually greater, the higher the domestic price for coffee (i.e. the lower the tax rate).

Turning to labor markets, Table 2 indicates that the removal of distortions in Labor markets would benefit rural labor whose wage rates would be bid up by the migration out of agriculture. Because the urban sector is more skill intensive than agriculture, the skilled urban wage would in all instances increase more than the unskilled urban wage rate. Therefore, if in fact there is a rising supply price to hired labor out of agriculture, a removal of differentials would benefit labor in general, though the gains would essentially accrue to the remaining labor in agriculture. Because distortions are not removed in the capital market, the average rate of return per unit of capital shows little variation.

Finally one can see that the removal of distortions would entail a small revaluation of the peso. The revaluation would be smaller (and in one case would become a devaluation) if capital stocks are fixed, because factor rigidity increases the price adjustment necessary to eliminate excess demands in non-traded sectors. As can be seen from Tables 3, relative prices of non-traded goods do not all change in the same direction, so that it is difficult to predict <u>a priori</u> whether factor immobility will increase the magnitude of the exchange rate adjustment or not. In general, one cannot

say whether there will be a revaluation or a devaluation, since it depends on the magnitude and relative intensity of the distortions in the non-traded sectors.

2) Structural Effects

Table 3 describes the new allocations of factors after a removal of differentials in both labor markets, along with the corresponding changes in outputs and value-added. Two experiments are reported in that table: in case (A-3) capital stocks are fixed while in case (B-3) they are not. Perhaps the first notable feature of the table is that prices do indeed change when distortions are removed. Consider post-distortion sectoral values-added as a percentage of initial values-added in column 1, i.e. case A-3. As shown, they are substantially affected by the removal of wage distortions.[10/] For traded sectors, net prices are mainly affected by the exchange rate adjustment which in this case is a revaluation of 5.7%. However, due to the presence of non-traded goods whose prices are endogenously determined, adjustments in value-added among traded sectors will differ (see net price equations in appendix). For non-traded goods, an increase in the price of inputs raises value-added as is the case for services and

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10/ To remedy the fixed net price assumption, Floystad tested his results by choosing different sets of net prices and found that his results were quite sensitive to the selection of net prices. See his tables 7 and 8, p. 211. On this basis, one can conjecture that the results in Table 3 would have been quite different had prices been fixed.

Table 3

Optimal Employment and Output with Capital Stocks Fixed (elasticity of substitution = 1)
(All figures are percentage of Actual Values)

	Value-Added		Unskilled Labor		Skilled Labor		Physical Output		Rate of Return on Capital	
SECTOR	A-3	B-3	A-3	B-3	A-3	B-3	A-3	B-3	A-3	B-3
Coffee	1.035	1.009	1.062	.957	.987	.879	1.019	.904	1.063	.960
Agriculture	.932	.928	.894	.743	.822	.654	.952	.679	.882	.810
Food, Beverage, Tobacco	.897	.875	2.152	1.381	.873	.537	1.124	.632	1.008	.744
Textiles & Apparel	.899	.886	2.215	2.627	.924	1.051	1.282	1.334	.870	1.568
Paper, Wood, Leather	.903	.879	2.530	3.053	1.143	1.323	1.311	1.396	1.189	1.652
Rubber & Chemicals	.910	.902	3.630	5.713	1.662	2.508	1.297	1.814	1.179	2.104
Metals & Products	.911	.889	2.434	2.846	.927	1.040	1.270	1.322	1.156	1.545
Nonmetallic Products	.890	.880	2.258	2.766	.881	1.035	1.322	1.409	.859	1.668
Mining & Petroleum	.959	.941	.855	.539	.955	.577	.968	.570	.922	.631
Machinery	.918	.907	4.592	16.263	1.717	5.829	1.688	5.358	1.546	6.252
Diverse Industries	.904	.894	2.837	6.553	.866	1.333	1.369	1.942	1.242	2.272
Light Domestic Ind.	.459	.729	2.297	3.053	.943	1.235	1.163	.851	.533	1.151
Construction	.564	.613	1.302	1.323	2.706	2.538	1.371	.875	.774	1.331
Transport & Commun.	.599	.751	1.071	1.253	2.329	2.521	1.157	.902	.695	1.171
Services & Artisans	1.338	1.286	.833	.854	.980	.953	.938	1.168	1.256	.996

artisans, a sector whose wages are below average (see Table 1). The results in Case A-3 show that equating wages to their respective marginal products would result in substantial output gains in the industrial sector. These gains would be mainly at the expense of agriculture and services and artisans which show a decline in output of 4.8% and 6.2% respectively.

The changes in the rate of return to capital are an indicator of the resource pull on capital. Those sectors whose rate of return increase most would draw capital in from those sectors whose rate of return decline most.

Case B-3 indicates the effects of relaxing the fixed capital stock assumption. Compared with Case A-3, sectoral contractions and expansions are generally more pronounced when capital stocks can be relocated among sectors. This, however, is not always the case since the relative factor intensity of expanding and contracting sectors affects the rate of return to capital which in turn determines the allocation of capital between sectors. Moreover, in the case of non-traded goods, the price adjustment is dampened by increased factor mobility (e.g. the net price of services increases by 28.6% instead of 33.8%). This price adjustment is dampened because increased factor mobility reduces excess demand (supply) which in turn reduces the price adjustment necessary to eliminate that excess demand.

Maintaining a constant rural urban wage differential for all factors precludes factor migration in response to a change in wage structure between rural and urban areas following the removal of differentials. Yet, both cases indicate a migration of factors towards the urban sector. The explanation

for this result is to be found in the adjustment of the relative prices of non-traded goods. This change in relative prices alters the consumption pattern which provokes a migration of factors out of agriculture.

Another interesting adjustment is captured by the model: in case A-3 coffee output shows 4% decline while in case B-3coffee output increases by 1.9%. Yet, in both instances quantities exported are the same. This different output adjustment is due to the deliveries from the coffee sector to the food industries which expand when capital stocks are fixed but contract when they are not.

This last point illustrates some of the important adjustment mechanisms captured by a general equilibrium analysis which insures consistency between aggregate supply and aggregate demand. The results in Table 3 show that there are substantial interactions between the agricultural and urban sectors. While this analysis does not provide a detailed treatment of the linkages between agricultural and non-agricultural sectors, as a resource allocation model portraying a dualistic economy, it attempts to incorporate some of the likely interactions between the rural and urban sectors. In addition, the results in Table 3 indicate that the assumption of fixed prices found in other empirical estimates of distortions in factor markets is likely to seriously underestimate the reallocation of factors brought about by a removal of factor market distortions.

TABLE 4

Optimal Employment, Capital and Output with Capital Stocks Shiftable Between Sectors Under Alternative Magnitudes of the Elasticity of Substitution Between Aggregated Labor and Aggregated Capital
(All figures are percent of actual values)

SECTOR	Unskilled Labor			Skilled Labor			Capital Stock			Physical Output		
	σ_i=0.5	σ_i=1.0	σ_i=1.5	σ_i=0.5	σ_i=1.0	σ_i=1.5	σ_i=0.5	σ_i=1.0	σ_i=1.5	σ_i=0.5	σ_i=1.0	σ_i=1.5
Coffee	.965	.957	.945	.899	.879	.846	.874	.904	.925	.958	.960	.958
Agriculture	.840	.743	.682	.752	.654	.557	.706	.679	.682	.858	.810	.768
Food, Beverage, Tobaco	1.212	1.381	1.524	.478	.537	.580	.665	.632	.570	.736	.744	.729
Textiles & Apparel	2.366	2.627	2.885	.960	1.051	1.129	1.465	1.334	1.172	1.555	1.566	1.567
Paper, Wood, Leather	2.608	3.053	3.484	1.146	1.323	1.476	1.491	1.396	1.241	1.586	1.652	1.686
Rubber & Chemicals	3.670	5.713	8.328	1.635	2.508	3.576	1.622	1.814	1.835	1.701	2.104	2.475
Metals & Products	2.429	2.846	3.247	.901	1.040	1.161	1.394	1.322	1.189	1.480	1.545	1.576
Nonmetallic Products	2.713	2.766	2.865	1.030	1.035	1.049	1.663	1.409	1.184	1.758	1.668	1.605
Mining & Petroleum	.550	.539	.508	.958	.577	.532	.552	.570	.574	.624	.631	.626
Machinery	11.231	16.253	22.451	4.087	5.829	7.876	5.211	5.358	5.054	5.138	6.252	7.400
Diverse Industries	3.817	4.553	5.325	1.134	1.333	1.525	2.063	1.942	1.740	2.144	2.272	2.371
Light Domestic Ind.	2.451	3.053	3.461	1.015	1.235	1.327	.947	.851	.789	1.111	1.151	1.185
Construction	1.256	1.323	1.360	2.485	2.538	2.559	.992	.875	.823	1.305	1.331	1.352
Transport & Commun.	1.120	1.253	1.326	2.316	2.521	2.628	.965	.902	.869	1.134	1.171	1.199
Services & Artisans	.874	.854	.833	.999	.953	.905	1.056	1.168	1.273	.977	.996	1.012
								Welfare (%)		.8	1.3	1.7

The effects of systematic variations in the elasticity of substitution between capital and labor on resource allocation are indicated in Table 4. Raising the elasticity of substitution decreases the rate of change of the marginal product of labor or capital when it is added to or withdrawn from a sector and therefore the greater the gain from reallocating capital and labor between sectors.[11] Raising the elasticity of substitution between capital and labor increases the migration of labor out of agriculture. It is notable that the expansion and contraction of sectors are not always a monotonous function of the elasticity of substitution. For example, physical output in textiles and apparel, food beverages and tobacco, and mining increases when the elasticity of substitution is raised from 0.5 to 1.0 and subsequently decreases as the elasticity of substitution is further increased to 1.5. With the exception of these sectors, the other urban sectors increase their output when factor substitution is eased.

V. CONCLUSIONS

This paper has presented a general equilibrium WPE model with an empirical application to analyze the effects of factor market distortions on welfare and economic structure. The model has been specified to incorporate the differential wage structures specified in the theoretical analyses of factor market distortions.

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[11] The percentage gains in terms of utility and GNP are roughly equivalent to those reported by D-S in their appendix (p. 390).

The empirical application of the model to Colombia has been constrainted by data availability. At the level of aggregation specified in the study it was only possible to obtain data on labor broken down into two skill categories. Therefore, the results are somewhat tentative, and more definite statements about the static costs of the misallocation of labour should await more work with labor disaggregated into further skill classes.

However, the results in this paper indicate that the efficiency gains from removing distortions in the labor market are likely to be significant, at least for developing countries such as Colombia. Previous estimates of the effects of these distortions using a simpler methodology concluded that the gains from removing such distortions were likely to be of a second order of magnitude. It appears that the low magnitude of the efficiency gains were due to the methdology and the assumptions in these studies resulting in fixed product and factor prices. Therefore, until further empirical estimates become available, one should not rely upon the inferences drawn from abstract two-commodity, two-factor models (Fishlow and David 1961, Johnson 1966) suggesting that factor price distortions lead to little loss in economic efficiency; neither should one rely on empirical estimates based on a partial equilibrium analysis neglecting wage and price adjustments caused by a removal of factor price distortions.

APPENDIX

To facilitate expositon, the following notation is adopted throughout: Greek letters and lower case Roman letters refer to exogenous parameters whose values are given to the model; upper case Roman letters refer to endogenous variables, but upper case Roman letters with a bar are used for exogenous variables. There are $n=q_1 + q_2$ goods produced in the economy; q_1 of these goods are traded; the remainder q_2 are classified as non-traded; Non-competitive imports are lumped into a sector,o. Superscripts are used to distinguish between the initial distorted situation (zero) and any other situation (one). To save space only the Cobb-Douglas version is reported in the model summary. The corresponding equations for the two-level C.E.S specification are based on Sato (1967). In this case, to ensure that the same output levels be obtained with an identical set of sectoral factor stocks, it is necessary to recalculate aggregate (capital and labor) as well as individual factor shares. The equations, as well as the solution techniques applied to this system of non-linear equations, may be found in de Melo (1975).

Note that, although not explicitly incorporated, ad valorem tariffs and subsidies separate domestic prices from world prices. Domestic prices equal world prices times one plus the ad valorem tariff times the exchange rate R which is determined through the normalization equation (eq.6) so as to maintain the balance of payments in equilibrium. The price normalization equation (6) determines a price level such that base year GNP valued at current prices remains constant. Finally the difference between government expenditures and tax revenues is covered by direct taxes which do not appear explicitly in the model.

MODEL SUMMARY

		Number of Equations
	Production Functions	
(1)	$X_i = A_i \prod_{\lambda}^{i=1\ldots n} R_{\lambda i}^{\alpha_{\lambda i}} \; ; \; \lambda = 1\ldots s$	n
(1')	$X_i = A_i \left[\gamma_i K_i^{-\rho_i} + (1-\gamma_i) L_i^{-\rho_i} \right]^{-V_i/\rho_i}$	
	Factor Demand Equations	
(2)	$P_i^* \frac{\partial X}{\partial R_{\lambda i}} = W_\lambda$	n·s
	Factor Differential Equations	
(3)	$W_{\lambda i} = d_{\lambda i} \hat{W}_\lambda$	s
	Rural-Urban Wage Differential	
(4)	$\theta_\lambda^1 = \theta_\lambda^o$	s
	where $\theta_\lambda = \frac{\sum_h w_{\lambda h} R_{\lambda h}}{\sum_j W_{\lambda j} R_{\lambda j}} \frac{\sum R_{\lambda j}}{\sum_h R_{\lambda h}}$; $h = 1,2$ $\quad j = h+1\ldots n$	
	Net Price Equations:	
(5)	$P_i^* = P_i - \sum_j a_{ji} P_j - a_{oi} P_o$	n
	Price Normalization Equation:	
(6)	$\sum_i P_i^{*1} X_i^o = \sum_i P_i^{*o} X_i^o$	1
	Consumption Equations:	
(7)	$C_i P_i = P_i \delta_i + \gamma_i \left(Y - \sum_j P_j \delta_j \right)$	n-1
	where $Y = \sum_i C_i P_i$	
	Resource Constraints:	
(8)	$\sum_i R_{\lambda i} = \bar{R}_\lambda$	s
	Flow Balance Equations	
(9)	$X_i - T_i - \sum_i a_{ji} X_i - a_{oi} X_i = C_i + Z_i$; $T_i = o$ for $i > q_1$	n
(10)	$\sum_k \pi_k T_k - \pi_o \sum_i a_{oi} X_i = \Delta$; $k = 1\ldots q_1$	1

LIST OF VARIABLES AND PARAMETERS

X_i, C_i, $\bar{Z}_i$	Gross output, private consumption and exogenous demand (Government demand + investment demand + depreciation) in sector i.
$R_{\lambda i}$	Use of primary factor λ. Estimates of sectoral capital stocks are from Berry (1974)
$\hat{W}_\lambda$	Average wage of primary factor λ .
P_i, P_i^*	Domestic and net price (inclusive of tariffs and subsidies) of sector i.
T_k	Quantity traded (competitively) of sector k (> o for exports) $\bar{T}_1$ fixed by quota export coffee tax.
$\alpha_{\lambda i}$	The exponent for factor λ in sector i . The exponent for capital, α_{ki}, is derived residually, i.e., $\alpha_{ki} = V_i - \sum_{\lambda \neq k} \alpha_{\lambda i}$
V_i	Returns to scale in sector i : $V_{1 \ldots k=.9}$; $V_{k+1 \ldots n} = 1$
a_{ij}, a_{oi}	Physical input-output coefficient and non-competitive import of sector i.
$\bar{A}_i$	Normalizing constant (shift parameter) defining units of measurement for sector i; calculated from eq. 1 using base year values.
Δ	Trade gap measured at world prices.
γ_i, δ_i	Marginal expenditure share and subsistence minimum for sector i. These were obtained from Howe (1974).
$d_{\lambda i}$	Differential wage scale parameter for primary factor R_λ. These parameters are the weights defininig the average wage $\hat{W}$ in the base period so that $\sum_i d_{\lambda i}(R_{\lambda i}/\bar{R}_\lambda) = 1$
Y	Total private expenditures.
Π_k	World price of commodities produced by sector k; $k=1 \ldots q_1$
θ_λ	Ratio of the wage of factor λ in agricultrue to the wage of factor λ in the urban sector.

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MEASURING THE EFFECTS OF PROTECTION ON RESOURCE ALLOCATION*

by

Jaime de Melo

Agency for International Development
Bureau for Program and Policy Coordination

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MEASURING THE EFFECTS OF PROTECTION ON RESOURCE ALLOCATION

I. Introduction

During the past decade applied trade economists have used extensively the concept of effective protection. Effective rates of protection (ERPs) have usually been estimated in a partial equilibrium framework under the assumptions of pure competition, unchanged factor prices, infinite foreign elasticities of demand (for exports) and supply (of imports) and zero substitution elasticity between inputs. If all goods are traded and the country has no monopoly power in trade, it has been argued that a ranking of industries by ERPs may correctly predict the direction of resource shifts resulting from a change in trade policies. By using output elasticities, ERPs can also be used to measure the resulting sectoral output changes. Under these assumptions, production and consumption effects can be separated; the former are measured by the ERP and the latter by the nominal rate of protection.*

As soon as the presence of non-traded goods is recognized, this simple separation of production and consumption effects breaks down since the production and consumption of non-traded goods have to be

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*See Leith (1971) for an analysis of the effects of tariffs on production, consumption and trade.

brought into equality through a price adjustment for each of these goods. And, if there are any links between non-traded and traded goods through substitution effects in production and/or consumption, it follows that, for the system as a whole, production and consumption effects may no longer be separated. More recently, theoreticians have discussed the consequences of introducing input substitution and have derived the definition of a general equilibrium ERP index in the absence of non-traded goods. Ethier (1971) has shown that introducing substitution gives rise to problems in defining value-added and the effective rate of protection. Bhagwati and Srinivasan (1973) have derived, in a general equilibrium model with more factors than final goods and with separable production functions, a physical measure of value-added for "local" changes in tariffs so that the first term (ERP index) represents the proportionate change in the"price" of a physical unit and the second term represents the proportionate change in the quantity (in physical units) of value-added (1973, p. 263). Finally, it has been pointed out that, regardless of the presence of non-traded goods, a ranking of ERPs will not indicate the relative intensity of resource shifts if factor prices are allowed to vary. Thus, in a three commodity model it is possible for commodity A, having a lower effective rate than commodity B, to enjoy greater protection if it is complementary in factor use with unprotected commodity C so that it benefits from a

protection-induced decline in the prices of primary factors it uses intensively.[1]

These criticisms concerning the neglect of factor price effects, substitution possibilities among inputs, and the treatment of non-traded goods, have been raised by trade theorists whose concern has often been to bring out the possibility of situations giving rise to paradoxes and counter-examples. These criticisms have been useful in helping ERP enthusiasts revise some of the early claims made about effective protection. But, in the meantime, the methodology has gained widespread use and has provided us with valuable information about the structure of protection in developed and developing countries. Because of their widespread use and because tariff structures are among the policy instruments governments may use to influence resource allocation it is of great practical interest not only to understand how well effective protection performs as a qualitative indicator of resource allocation under various commercial policies, but also to what extent it may help us in quantifying these changes in resource allocation.

The purpose of this paper is: (1) to present estimates of the effects of protection on resource allocation obtained from a general equilibrium resource allocation model featuring non-traded goods, direct substitution in supply and demand; and (2) to compare these results with those one would obtain using a partial equilibrium methodology.

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[1] See Balassa (1971a) for a discussion of the possible magnitude of these effects. The list of major contributions to the concept of effective protection may be found in the bibliography of Gruebel and Johnson (1971) and in the symposium published by the Journal of International Economics (1973).

The next section describes briefly a Walrasian general equilibrium trade model applied to Colombia to study the effects of price distortions on sectoral resource allocation. The following section presents estimates of the effects of protection in Colombia obtained from the model. The final section compares these results with those which might be obtained using a partial equilibrium analysis .

II. A General Equilibrium Trade Model

This section describes briefly the model used to study the effects of trade policies on resource allocation. Its primary purpose is to provide insights on the long-run structural consequences of alternative trade policies after all adjustments have taken place and it will be used as a basis for comparison between general and partial equilibrium estimates of resource pulls under trade liberalization. A distinctive feature of the model is that the various agents in the economy-- producers and consumers -- may interact through a variety of specifications of market behavior which lend themselves easily to the incorporation of price distortions.[2]

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[2] See Johansen (1960) for the formulation of the first multi-sector non-linear model. His model, and Taylor-Black (1974) whose specification of the foreign trade sector is similar to this one, were linear in growth rates, and so could be solved as a set of simultaneous linear equations. The Walrasian approach which is used here, involves directly solving for a set of market clearing prices and wages for a specified market behavior. As such it is better suited for a variety of specifications of market behavior than a programming approach where it is difficult to analyze the effects of changing preexisting price wedges such as tariffs and indirect taxes. See Adelman-Robinson (1975) for a discussion and comparison of the Walrasian and programming approaches.

Some specific features of the model are outlined here and the reader is referred to the appendix for a list of equations, variables, and parameters. On the supply side, producers maximize profits subject to a Leontief technology for intermediate inputs and non-competitive imports. For value-added, Cobb-Douglas and two-level C.E.S. production functions are specified.[3] Full employment of all factors is maintained, and factor wages are endogenously determined. On the demand side, the representative consumer maximizes a Stone-Geary utility function. When maximized subject to a budget constraint, it yields the linear expenditure system. The parametric restrictions imposed on the utility function rule out inferior and complementary goods.[4] The model, therefore, incorporates direct substitution in both production and demand to reflect changes in consumption patterns and choice of production techniques resulting from changes in the relative price of outputs and inputs.

As specified here, the role of the government is concentrated in the foreign trade sector of the economy. It imposes tariffs, taxes and subsidies on traded commodities. Because there are no equations linking factor payments, savings and total consumption, direct taxes on factor incomes do not appear in the model. However, the difference between government expenditures and revenues from trade policy are covered by direct taxes so that the government budget is implicitly balanced under different trade policies. Since the model is designed for comparative statics, investment remains exogenously fixed in base year prices.

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[3]Cobb-Douglas production functions impose unitary elasticities of substitution across all factors while two level C.E.S. production functions allow for other than unitary elasticities of substitution between aggregated capital and aggregated labor. However, all experiments reported here refer to C-D functions.

[4]As stated, the LES satisfies the conditions of: (1) homogeneity of degree zero in prices and income; (2) the budget constraint; and (3) the Slutsky Symmetry.

There is no explicit introduction of money in the model; therefore, only relative prices can be determined and one has to choose a normalization rule. To compare relative prices, it is convenient to maintain a constant price level, thereby implying that monetary authorities control the money supply during the resource shifts between sectors. This amounts to determining a price level such that base year GNP valued at current prices remains constant. The exchange rate is flexible and adjusts to maintain balance of payments equilibrium. Alternatively one could have assumed a fixed exchange rate and a fluctuating trade gap. This alternative is not considered so as to make results more directly comparable to those obtained in partial equilibrium analysis where some estimates of the likely exchange rate adjustment are provided.

In the context of a small country assumption, Samuelson (1953) has shown that in a perfectly competitive model with n final goods and s primary factors where $n>s$, the over-determination resulting from more fixed prices through trade than variable factor prices resolves itself through the country specializing in the production of s commodities. Although it is easy to brush aside the specialization problem in theoretical models by specifying more factors than commodities, in practice one is

limited by data availability and one has to recognize that empirically measurable commodities do outnumber primary factors of production. In this model, there are eleven traded sectors and four primary factors of production have been specified: skilled labor, unskilled labor, capital and land, whose use is restricted to the agricultural sectors.[5] The model also assumes mildly decreasing returns to scale, thereby allowing for selective specialization according to comparative advantage since there are no bounds on quantities traded (unless the country faces a quota on world markets as Colombia does for coffee). It is argued that import substituting industries face rising supply costs while on the export side it is argued that increasing exports involve market development (or transport) costs.[6]

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5 In a multi-sector framework, it is customary to overcome the "specialization problem" by dropping the small country assumption and/or, in an activity-analysis format, by specifying fixed factors and bounds on quantities traded. (See Evans 1972). Taylor-Black (1974) fix capital stocks so that they are restricted to the short-run effects of tariff-cuts while ERPs purport to measure the long-run response after all adjustments have taken place.

6 The economic justification for rising supply costs in import substituting industries follows Weisskof's (1971) and Ali's (1975), studies of import substitution in India. Owing to the high level of aggregation common in multi-sector models, sectoral production functions are used as proxies for all industries included in a sector, thereby losing information about the relative comparative advantage of industries within the sector. Defining for each of these industries, their average cost as the domestic factor cost needed to save one unit of foreign exchange, one can derive the sector's stepped supply curve by ranking industries according to their costs. Taking a concrete example, the costs of replacing a dollar's worth of, say, metal products varies according to the particular commodity produced. An expansion (contraction) involves moving up (down) the steps on the curve to a successively higher (lower) cost industry. Ali (1975) has derived the relation between cost, efficiency and output using a neoclassical production function. Here, as will be seen later in section IV, it is more convenient to assume decreasing returns to scale since the objective is to compare results with those obtained using ERPs. (See specification in the appendix)

The introduction of increased factor mobility reflecting long-run conditions makes it desirable to consider large changes in relative prices, including a return to free trade. Such parametric variations prohibit linearization techniques used to approximate non-linear models and adopted by Johansen and Taylor-Black; instead the model was solved using a tâtonnement process in factor markets.[7] Having briefly outlined the model, we now turn to an empirical application and examine the effects of a removal of trade distortions in Colombia.

III. An Application of the Model: Protection and Resource Allocation in Colombia

The model outlined above will now be used to estimate the effects of protection in Colombia, taking 1970 as the base year. The sectoral classification reported in Table 1 indicates that eleven out of the fifteen sectors are traded.[8] Though not indicated in that table, two sectors use land: coffee and agriculture. The reason for not lumping these sectors together is that, though there is scant information as to how they should be distinguished on technological grounds, they enter foreign trade in quite a different manner since Colombia has a quota share on the world

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7 Linearization constrained Taylor-Black to examine (10-20%) reductions in tariffs. They report that a typical experiment took 5.4 CPU minutes. The algorithm used here only involves a couple of CPU seconds on a similar computer for a system of equations with nearly as many equations.

8 See de Melo (1975) and the appendix for the data sources particulary those on price distortions which take into account the tariff equivalents of quotas.

TABLE I

Tariff - Ridden Solution

1 4	TARIFF	DOMESTIC PRICE	VALUE ADDED	OUTPUT PHYSICAL	OUTPUT VALUE	CONSUMPTION PHYSICAL	CONSUMPTION VALUE	TRADE DOMESTIC	TRADE WORLD	CAPITAL STOCK	UNSKILLED LABOR	SKILLED LABOR
COFFEE	-44.0	1.000	97.2	54.864	54.864	0.0	0.0	42.079	75.141	120.610	470.091	32.145
AGRICULTURE	3.4	1.000	84.2	296.366	296.366	196.276	196.276	12.218	11.822	747.780	1979.165	132.711
FOOD,BEVERAGE,TOBACO	3.7	1.000	32.1	140.341	140.341	102.657	102.657	15.161	14.622	109.270	42.587	14.536
TEXTILES & APPAREL	15.6	1.000	46.4	81.789	81.789	54.370	54.370	0.964	0.833	107.810	73.925	13.122
PAPER,WOOD,LEATHER	12.2	1.000	41.2	31.025	31.025	8.406	8.406	-1.511	-1.348	38.080	18.618	4.762
RUBBER & CHEMICALS	46.0	1.000	63.1	66.259	66.259	21.042	21.042	-15.812	-10.830	82.320	20.827	12.102
METALS & PRODUCTS	56.2	1.000	37.0	44.344	44.344	0.0	0.0	-18.800	-12.033	55.230	25.176	5.950
NONMETALLIC PRODUCTS	4.7	1.000	50.2	19.687	19.687	7.182	7.182	0.554	0.529	42.220	21.660	4.175
MINING & PETROLEUM	-0.2	1.000	63.2	48.244	48.244	1.999	1.999	5.572	5.585	134.990	76.387	2.419
MACHINERY	144.6	1.000	59.9	21.804	21.804	1.424	1.424	-4.958	-2.027	25.250	14.180	5.024
DIVERSE INDUSTRIES	149.1	1.000	57.4	24.127	24.127	24.097	24.097	-15.071	-6.050	28.270	22.254	5.780
LIGHT DOMESTIC IND.		1.000	54.9	50.767	50.767	12.701	12.701			40.040	13.633	5.982
CONSTRUCTION		1.000	67.5	111.300	111.300	91.207	91.207			201.490	318.523	7.269
TRANSPORT & COMMUN.		1.000	71.4	116.692	116.692	24.625	24.625			326.160	217.623	8.001
SERVICES & ARTISANS		1.000	91.4	374.944	374.944	203.083	203.083			731.310	1884.512	306.120

coffee market amounting to 14% of world production in that year. Since Colombia filled its quota share, I have determined that export tax which would keep the value of Colombian coffee exports, measured at world prices, equal to their initial value prior to removal of tariffs and subsidies in the other sectors.

Table I provides a description of the Colombian economy in the tariff-ridden base year. In addition to distortions in product markets, factor wage differentials observed in that year are taken as representative of differentials due to differences in the quality of the labor force across sectors or regions and/or policy imposed distortions on labor and capital markets. Since 1970 was a fairly "typical" year in Colombia, at least in the foreign trade sector, Table I is assumed to represent an equilibrium with factor and product market distortions. While such a representation may be questionable, especially for an LDC, it has a great empirical advantage in that the tariff-ridden solution obtained from the model is quite close to the observed allocation in the base year.

Returning to Table I, column 1 indicates the percent ad valorem tariff structure. A negative sign indicates that the sector is a net exporter and has an export tax. Otherwise the price distortion is a subsidy or a tariff according to whether that particular

sector is a net exporter or a net importer. The net trading status may in turn be determined by looking at the signs of quantities traded in either column 8 or 9 (+ for exports - for imports). Column 2 indicates that distorted domestic prices are set equal to unity for the base year. Percentage value-added comes next, followed by gross sectoral outputs in physical and value terms. These two sets of figures are necessarily equal in the base year since prices are set equal to one. The same argument applies to private final demand reported in columns 6 and 7. Exports and imports valued at domestic prices come next, followed by their values at world prices. Finally the last three columns, ten to twelve[9], provide estimates for factor stocks in the base year.

Table II reflects the effects on sectoral resource allocation of removing tariffs and subsidies with capital (and land) fixed; it may be viewed as the short-run response of the economy to the removal of the tariff structure. Here it is assumed that the capital stock in each sector is exogenously given. This implies that the sectoral rates of return to capital are calculated from the equations determing the sectoral demands for capital. As indicated, the table gives the percentage change of the variables entered in Table I.

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[9] All figures are in Colombian pesos x 10^8. Capital stocks are valued in the same units as gross outputs, consumption and trade. Labor stocks are in thousands of man-years. Valued at base-year prices GNP is 107 billion pesos. About one half of GNP is classified as tradable and 12% of GNP is traded. The share of GNP accruing to unskilled labor is 30.3%; to skilled labor 15.4%; to capital 38.7; and 8.2% to land.

TABLE 2

FREE TRADE SOLUTION (CAPITAL·STOCKS FIXED).

PERCENTAGE CHANGE OVER INITIAL SOLUTION

1			OUTPUT		CONSUMPTION		TRADE				
2	TARIFF	DOMESTIC PRICE	VALUE ADDED	PHYSICAL	VALUE	PHYSICAL	VALUE	DOMESTIC	WORLD	CAPITAL STOCK	UNSKILLED LABOR	SKILLED LABOR
COFFEE	7.2	5.2	5.4	0.8	6.0	0.0	0.0	5.2	-0.0	0.0	2.2	7.0
AGRICULTURE	-100.0	7.-	10.0	2.8	11.0	-7.3	-0.0	197.8	176.0	0.0	8.8	13.9
FOOD,BEVERAGE,TOBACO	-100.0	7.5	15.7	5.4	13.3	-6.9	0.1	107.7	93.1	0.0	17.2	22.7
TEXTILES & APPAREL	-100.0	-3.6	-3.7	-5.0	-8.4	1.2	-2.4	-377.0	-387.2	0.0	-12.0	-7.9
PAPER,WOOD,LEATHER	-100.0	-0.6	4.9	1.9	1.3	-1.6	-2.2	-127.6	-127.8	0.0	2.8	7.6
RUBBER & CHEMICALS	-100.0	-23.6	-32.0	-16.3	-36.0	26.6	-3.3	42.1	86.0	0.0	-45.2	-42.6
METALS & PRODUCTS	-100.0	-28.6	-42.6	-32.6	-51.9	0.0	0.0	-0.1	40.0	0.0	-62.9	-61.1
NONMETALLIC PRODUCTS	-100.0	6.5	12.2	9.3	16.4	-7.7	-1.7	534.2	495.5	0.0	17.9	23.4
MINING & PETROLEUM	-100.0	11.8	14.6	1.7	13.7	-12.1	-1.8	39.9	25.2	0.0	12.1	17.4
MACHINERY	-100.0	-54.4	-76.0	-71.2	-86.8	107.8	-5.2	85.3	306.5	0.0	-93.3	-93.0
DIVERSE INDUSTRIES	-100.0	-55.2	-82.9	-76.1	-89.3	113.3	-4.5	76.0	293.1	0.0	-96.1	-95.9
LIGHT DOMESTIC IND.		-2.4	-1.3	-1.6	-4.0	0.0	-2.3			0.0	-6.6	-2.2
CONSTRUCTION		-2.3	3.1	-0.1	-2.4	0.0	-2.3			0.0	-1.0	3.7
TRANSPORT & COMMUN.		-1.7	-0.2	-2.6	-4.2	-0.6	-2.3			0.0	-6.6	-2.2
SERVICES & ARTISANS		-0.0	0.0	-2.6	-2.6	-2.1	-2.1			0.0	-6.3	-1.9

Suppose, we wish to predict output response to changes in tariffs on the basis of price information. Starting with nominal prices, one can check, by comparing columns 2 and 4, whether nominal prices and physical outputs have the same sign. They do in all instances except for paper, wood and leather, where the price declines and output increases. In this case, it is necessary to examine the change in net price to correctly infer that output will expand. Turning to a comparison of the direction of value-added and output changes, construction is the only sector whose output response does not correspond to a priori expectations due to the effect of changes in factor prices. In all other instances, the output of sectors whose value-added was higher under protection declines when tariffs are removed, and vice-versa. On the basis of these results, one can conclude that in practice factor price effects are not likely to outweigh product price effects. Moreover, as expected, both nominal and net prices are good indicators of resource pulls in general equilibrium.

The short-run consumption response to a removal of tariffs is reported in columns 6 and 7.[10] Barring cross-price and income effects, the physical consumption of goods whose relative price increases declines

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[10]The parameters entering the demand system were obtained from Howe (1974). All subsistence minima are positive so that no good has an own price elasticity of demand above unity. Cross-price effects with respect to food are usually quite high. The matrix of expenditure and price elasticities can be found in de Melo (1975, p. 88).

TABLE 3

FREE TRADE SOLUTION (CAPITAL STOCKS MOBILE)

PERCENTAGE CHANGE OVER INITIAL SOLUTION

1 4	TARIFF	DOMESTIC PRICE	VALUE ADDED	OUTPUT PHYSICAL	OUTPUT VALUE	CONSUMPTION PHYSICAL	CONSUMPTION VALUE	TRADE DOMESTIC	TRADE WORLD	CAPITAL STOCK	UNSKILLED LABOR	SKILLED LABOR
COFFEE	0.1	8.8	9.1	12.5	22.4	0.0	0.0	8.9	0.0	20.2	16.0	22.7
AGRICULTURE	-100.0	5.4	7.2	4.0	9.6	-3.2	2.1	34.9	28.0	9.1	5.3	11.4
FOOD,BEVERAGE,TOBACO	-100.0	5.0	9.5	80.5	89.7	-2.8	2.1	741.9	701.4	93.6	86.8	97.6
TEXTILES & APPAREL	-100.0	-5.8	-7.7	-63.0	-65.2	6.7	0.5	-4594.7	-4871.9	-66.6	-67.7	-65.9
PAPER,WOOD,LEATHER	-100.0	-2.9	0.0	-22.0	-24.2	3.8	0.8	278.9	290.2	-23.6	-26.2	-22.0
RUBBER & CHEMICALS	-100.0	-25.4	-34.8	-98.2	-98.7	33.9	-0.1	270.8	397.0	-98.9	-98.9	-98.8
METALS & PRODUCTS	-100.0	-30.3	-46.1	-100.0	-100.0	0.0	0.0	67.2	139.9	-100.0	-100.0	-100.0
NONMETALLIC PRODUCTS	-100.0	4.0	7.6	45.2	51.0	-2.6	1.3	1773.0	1700.7	53.0	47.6	56.2
MINING & PETROLEUM	-100.0	9.2	11.1	38.5	51.2	-7.1	1.4	306.1	272.0	50.8	45.5	53.9
MACHINERY	-100.0	-55.5	-77.7	-100.0	-100.0	119.9	-2.1	125.9	407.3	-100.0	-100.0	-100.0
DIVERSE INDUSTRIES	-100.0	-56.3	-84.7	-100.0	-100.0	125.8	-1.3	93.8	343.4	-100.0	-100.0	-100.0
LIGHT DOMESTIC IND.		-0.1	2.6	-2.6	-2.7	1.1	1.0			-2.3	-5.6	-0.2
CONSTRUCTION		-1.7	4.1	2.1	0.3	2.7	0.9			4.0	0.4	6.2
TRANSPORT & COMMUN.		0.7	3.2	-1.7	-1.1	0.4	1.1			-0.8	-4.2	1.3
SERVICES & ARTISANS		2.6	2.7	-3.4	-0.9	-1.3	1.3			-3.0	-6.3	-0.9

and vice-versa. Comparing columns 2 and 5, this is so except in three instances where price and consumption have the same sign. Since there are only thirteen commodities entering private final demand, it appears that consumption response to tariff changes cannot be forecasted without taking into account expenditure and cross-price effects.

The trade pattern in the absence of tariffs and subsidies is reported in columns 8 and 9. It is noteworthy that textiles and apparel changes status and becomes an import under free trade. However, one cannot infer Colombia's comparative advantage on the basis of this information alone since comparative advantage refers to the long-run when all factors of production are perfectly mobile between sectors.

Table 3 provides the same information as Table 2 but differs in one important respect: capital and land are assumed to be mobile so that it describes the long-run structural changes resulting from a removal of trade distortions. The reader can verify that there are again a few instances where relative price changes do not correctly predict output responses but that relative net price changes are a good indicator of resource pulls for traded goods, and that for all but one non-traded sector, construction, the factor price effect outweighs the product price effect. Tests with a C.E.S. technology yielded similar results with identical output rankings for traded sectors. As suspected, the pattern of output response for non-traded sectors was found sensitive to the specification of technology because of the relative importance of changes in factor prices in determining output response. (See de Melo (1975)).

Table 3 indicates that the following sectors would not operate under free trade: diverse industries (which includes electrical and electronic goods), machinery and metal products. Rubber and chemicals would also disappear. Inspection of trade flows reveals that another sector, paper wood and leather becomes an import sector. On the basis of the pattern of trade, Colombia has a comparative advantage in agricultural products, food industries, mining (mainly petroleum) and non-metallic products. Since these sectors are relatively intensive in their use of unskilled labor, the relative price of that factor increases. Experiments with an infinitely elastic supply of unskilled labor at a fixed real wage indicated that a removal of trade distortions would increase employment of unskilled labor (by 5.4 percent in the short run and 9.0 percent in the long-run).

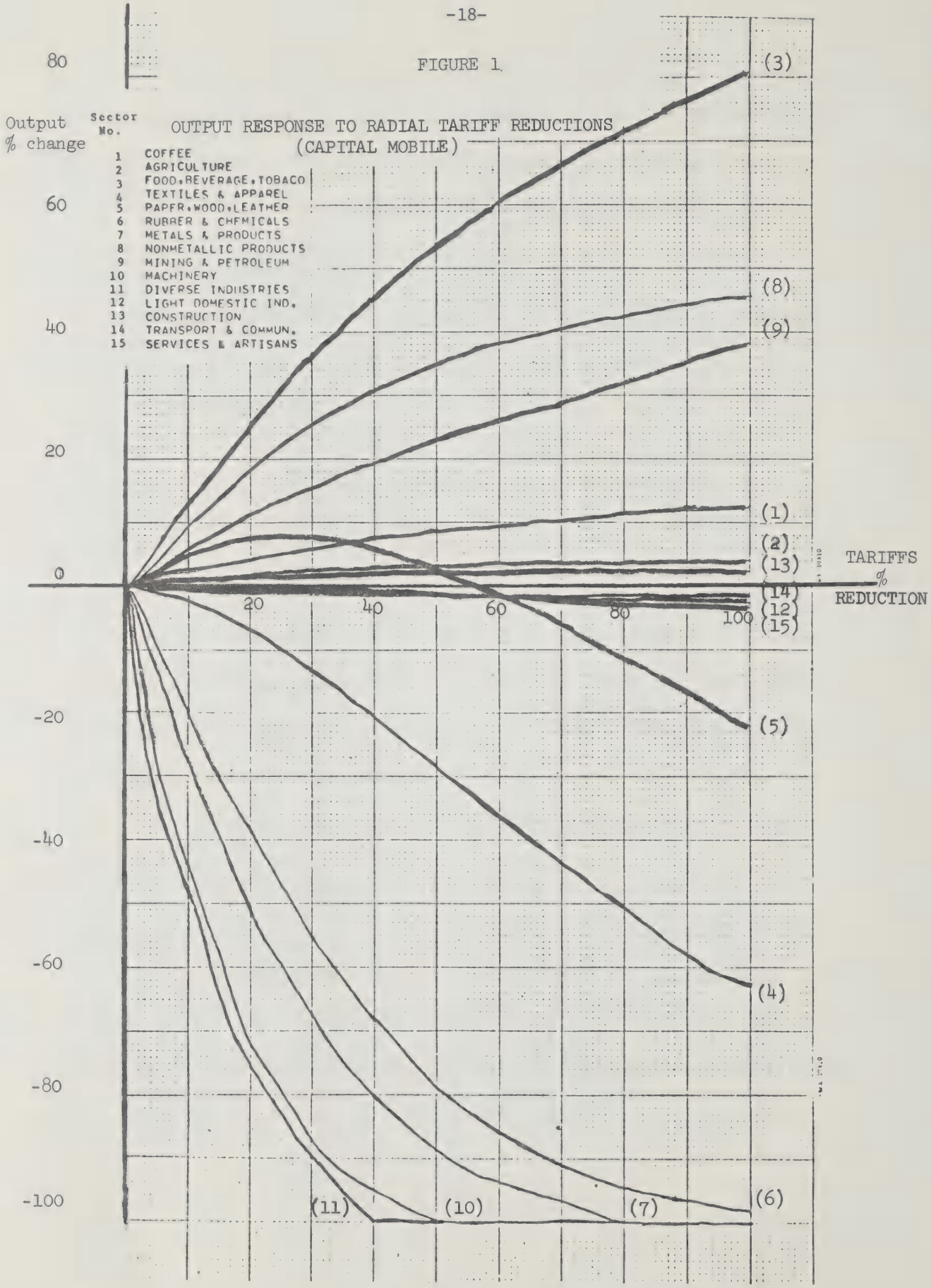
Non-traded sectors are indeed affected by the change in tariff structure. Three sectors contract due to the combined effects of: (a) inter-industry linkages embodied in the input-output table; (b) shifts in consumption away from non-traded goods and; (c) primary resources bid away by the expanding traded sectors. However, one sector construction, expands. This expansion is brought about by the interaction of several factors. On the one hand, that sector delivers a substantial amount of intermediate inputs to several expanding sectors including petroleum. Second, that sector enjoys a decline in the cost of its intermediate inputs and there is some substitution

among its primary inputs following the change in their relative prices. Finally there is an adjustment in the relative price to equate the supply and demand for housing by the private sector.

It is also interesting to note the effect on coffee and agriculture of introducting capital and land mobility. With land and capital fixed, the coffee tax rate has to be increased by 7.2%.so that the coffee quota is met after increased deliveries to the food industries are accounted for. With increased factor mobility, the adjustment in the coffee tax becomes negligible because capital and land are shifted into that sector. Despite a quota, the coffee sector expands to satisfy its deliveries to the food industries. As for agriculture, its expansion is limited as it is constrained by land which it has to share with coffee. It is also noteworthy that the price adjustment of non-traded goods (and therefore the exchange rate adjustment) is also greater when some factors are immobile. This is so because factor rigidity increases the price adjustment necessary to eliminate excess demands in non-traded sectors.

Although the model presented here is designed to study static rather than dynamic comparative advantage, it is interesting to analyze sectoral expansions and contractions resulting from radial reductions in tariffs and subsidies. One would expect sectors to contract and expand monotonically with respect to these successive reductions in tariffs; however, this is not the case. Figure 1 which depicts the output response of each

FIGURE 1.


OUTPUT RESPONSE TO RADIAL TARIFF REDUCTIONS
(CAPITAL MOBILE)
Output % change
Sector No.
1 COFFEE
2 AGRICULTURE
3 FOOD, BEVERAGE, TOBACCO
4 TEXTILES & APPAREL
5 PAPER, WOOD, LEATHER
6 RUBBER & CHEMICALS
7 METALS & PRODUCTS
8 NONMETALLIC PRODUCTS
9 MINING & PETROLEUM
10 MACHINERY
11 DIVERSE INDUSTRIES
12 LIGHT DOMESTIC IND.
13 CONSTRUCTION
14 TRANSPORT & COMMUN.
15 SERVICES & ARTISANS
80
60
40
20
0
-20
-40
-60
-80
-100
20
40
60
80
100
TARIFFS % REDUCTION
(3)
(8)
(9)
(1)
(2)
(13)
(14)
(12)
(15)
(5)
(4)
(6)
(11)
(10)
(7)

sector to radial tariff reductions reveals that sector 5, paper, wood and leather expands initially until tariffs are reduced by 30%, then contracts until it registers a 21% reduction under free trade. Note also that textiles and apparel (sector 4) contracts at an increasing rate for tariff reductions up to approximately 50%. The behavior of these two sectors exemplifies a possible interaction between traded and non-traded goods which would not be captured by a partial equilibrium analysis.[12]

To explain the behavior of textiles and paper, (sectors 4 and 5), it is necessary to consider their input requirements from non-traded sectors. Both of these sectors require substantial deliveries from transport and services (sectors 14 and 15). In fact, their intermediate input requirements from these sectors are well above those of other traded sectors. While both sectors have nominal and effective rates of protection which do not differ greatly, sector 4 uses unskilled labor more intensively than sector 5 which is therefore relatively more intensive in its use of skilled labor and capital. When tariffs are reduced by 10% across the board, the relative price of sectors 14 and 15 declines while the unskilled wage rate increases relative to the skilled wage and rate of return to capital. The combined effects of declining intermediate and primary input prices brings about an increase in output of sector 5. However, because the unskilled wage rate increases,

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[12]Note that the ranking of output changes is not invariant as one moves towards free trade and that such a change would not be captured by a ranking of ERPs which would be invariant under uniform tariff reduction across the board.

sector 4 cannot follow the same path as sector 5 and contracts. But increased intermediate input requirements from sector 5 soon brings about an increase in the relative prices of sectors 14 and 15 as smaller amounts of these goods remain to satisfy private final demand. Increased intermediate input costs induced by the rising supply prices of non-traded goods reduces the rise in value-added initially registered in sector 5 for small reductions in tariffs. Eventually, as tariffs are further reduced, and the relative prices of sectors 14 and 15 continue to rise in response to increased final demand, the initial output expansion of sector 5 turns into a decline as can be seen from figure 1. The bunching of non-traded goods around the horizontal axis indicates a small output response to tariff reductions conforming to a priori expectations.[13]

The results in this section indicate that relative net price and relative gross price adjustments are not an infallible indicator of resource shifts and consumption responses to large revisions in the tariff structure, even when they are estimated from the model. Moreover,we have seen that there are quantitatively significant links

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[13] A similar graph for the case of fixed capital stocks indicated a fairly linear output response to tariff reductions. In contrast with figure 1, the expansion and contraction of all sectors, including those of sectors 4 and 5, showed a very slight convexity to the origin. It is on the basis of such an experiment that Taylor and Black concluded that ERPs provided a good measure of output response to small tariff reductions.

between traded and non-traded sectors. The next section compares the results obtained by solving the model with those one would obtain in a partial equilibrium framework.

IV. A Partial Equilibrium Analysis of Price Distortions and Resource Allocation

We have just examined the effects of protection in a general equilibrium trade model. Because implementation of such a model requires a good deal of work, including substantial data collection and a fair amount of experimentation with solution techniques, it is desirable to find out how much information is lost by using a partial equilibrium analysis to measure the effects of price distortions on resource allocation.

Suppose we have some information about the tariff structure and the elasticity of supply, e_i, of commodity i. Then the percentage change in sectoral output for commodity i, X_i', following a change in tariffs, is given by:[14]

$$X_i' = e_i \, EP_i \qquad (1)$$

Where EP_i is the ERP for commodity i. However, use of (1) will not yield acceptable estimates of sectoral output changes since, unless some sectors have a negative ERP, a reduction in tariffs would, according to the above

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[14] See Leith (1971, p. 75), who also derives an expression for the change in consumption. Note that EP_i need not refer to a comparison between a tariff ridden situation and free trade but may refer to comparisons between two tariff-ridden situations.

formula, lead to reduction in sectoral output.[15] This may be remedied by using net ERPs to adjust for the extent of over-valuation as compared to the free trade situation. The exchange rate adjustment provided by the free trade solution of the model is used on the grounds that it is the "correct" adjustment under the given assumptions.

Taking sectoral technological structure to be defined by Cobb-Douglas production functions for primary factors, the short and long-run sectoral elasticities of supplies, e_i, may be derived by differentiating the sectoral production functions and the demand equations for primary factors and the resulting expression is:

$$x_i' = \frac{\sum_{\lambda} \alpha_{\lambda i}}{V_i - \sum_{\lambda} \alpha_{\lambda i}} \overline{EP_i} \qquad \begin{matrix} i = 1 \ldots q_1 \\ \lambda = 1 \ldots s \end{matrix} \qquad (2)$$

Where $\overline{EP_i}$ is the net ERP.[16] To conform with the partial equilibrium

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15 Taylor-Black, who used formula (1) to compare partial and general equilibrium predictions of resource shifts for local tariff revisions finessed this issue by assuming that all exports violated the small country assumption so that use of (1) resulted in a contraction for import competing sectors and an expansion for export sectors.

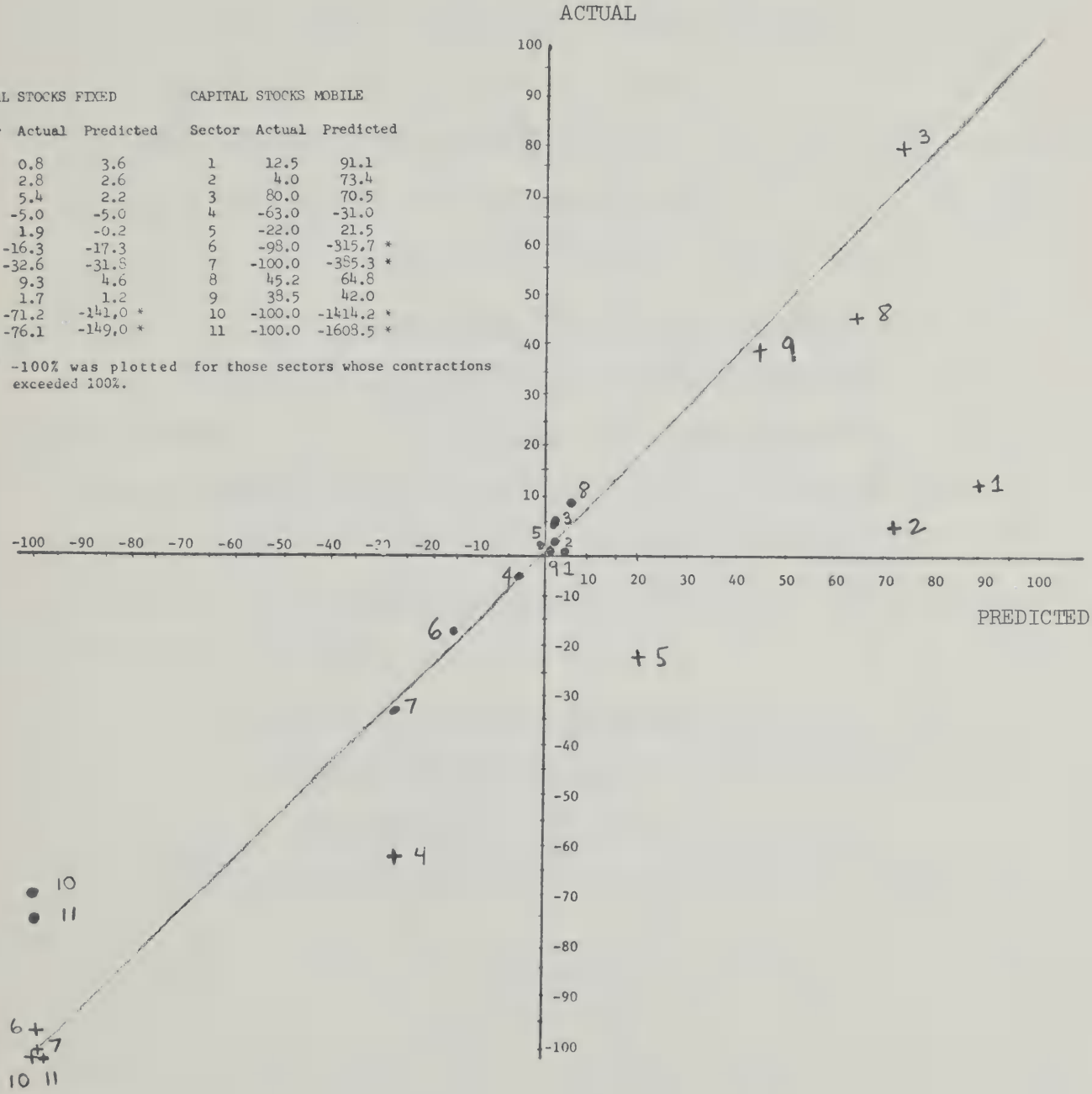
16 The necessity of assuming "decreasing returns to scale to resources in general'" (Johnson 1971, p. 369) can be easily seen from (2) since, with constant returns to scale ($V_i = 1$), the denominator of the first term on the RHS of (2) would be equal to zero. This point explains why the linearization problem discussed on page 6 was resolved here by assuming decreasing returns to scale. In the case where capital and land are fixed, their exponents drop out of expression (2). EP_i is defined here as the ratio of the difference between domestic value-added under protection and under free trade to domestic value-added under free traded and it is assumed that the price of non-traded goods remains unchanged between the two situations. The expression for the net effective rate of protection is given in Balassa (1971b, p. 324). As an alternative, (2) was also estimated using domestic rather than world value-added as demoninator for the expression determing EP_i. The predictive power of this version of the partial equilibrium model was no higher than the one reported in figure 2; for estimates in the first quadrant it yielded lower predicted values and vice-versa for estimates in the third quadrant.

FIGURE 2

ACTUAL AND PREDICTED CHANGES OF SECTORAL OUTPUTS: COBB-DOUGLAS VALUE-ADDED PRODUCTION FUNCTIONS. 100% REDUCTION IN TARIFFS (EXCEPT COFFEE)

CAPITAL STOCKS FIXED			CAPITAL STOCKS MOBILE		
Sector	Actual	Predicted	Sector	Actual	Predicted
1	0.8	3.6	1	12.5	91.1
2	2.8	2.6	2	4.0	73.4
3	5.4	2.2	3	80.0	70.5
4	-5.0	-5.0	4	-63.0	-31.0
5	1.9	-0.2	5	-22.0	21.5
6	-16.3	-17.3	6	-98.0	-315.7 *
7	-32.6	-31.8	7	-100.0	-385.3 *
8	9.3	4.6	8	45.2	64.8
9	1.7	1.2	9	38.5	42.0
10	-71.2	-141.0 *	10	-100.0	-1414.2 *
11	-76.1	-149.0 *	11	-100.0	-1608.5 *

* -100% was plotted for those sectors whose contractions exceeded 100%.



CAPITAL STOCKS MOBILE (+); CAPITAL STOCKS FIXED (•)

analysis, factor price adjustments are omitted from (2).

Figure 2 plots the output response predicted by equation (2) against the "actual" physical output response predicted by the model under the two assumptions about factor mobility. By plotting both sets of points one can see whether: (a) ERPs are a good indicator of resource shifts in the short-run when tariff revisions are substantial and: (b) there is any pattern in the divergences between "actual" and predicted reponses in the short-run and in the long-run.

Before examining successively these questions one point should be made: if ERPs are properly adjusted for overvaluation by choosing the exchange rate adjustment from the model (11.5% and 8.8% devaluations for fixed and mobile capital stocks), they correctly identify expanding and contracting sectors, since all but one set of observations (sector 5) in figure 2 lie in the first and third quadrants. Although this statement would have to be altered for tariff reductions other than a return to free trade because of the behavior of sector 5 discussed earlier, this result is nonetheless reassuring and extends the results obtained by Taylor-Black for small tariff revisions in the short-run. Moreover, as indicated in the appendix,there is a high rank correlation between ERPs and physical output changes.

Concerning the first of the issues raised here, figure 2 indicates that the partial equilibrium estimate is not a good predictor of output response in the short-run when tariff reductions are substantial. The "local" results obtained by Taylor-Black using linear approximations do

not extend to the case of large revisions in the tariff structure. Moreover, the margin of error does not show any systematic variation with the size of the output change, although the short-run predictions are usually closer to the 45^{o} line than the long-run estimates. Unfortunately the sample size of 11 is too small to allow for any generalization concerning a comparison of the two sets of estimates.

Returning to figure 2, one can examine the relation between the short-run and long-run output elasticities. With the exception of sector 5, all sectors which contract in the short-run, also contract in the long-run, although there are some changes in the ranking among sectors. The most notable of these concerns sector 3, whose short-run expansion is constrained by the high input costs from sector 1 due to the fixity of land in producing coffee. Naturally, this is an effect which is not captured by the partial equilibrium model where the coffee tax rate is exogenously determined.

As mentioned earlier, ERPs and equation (2) do not take into account factor price adjustments. While in most instances such a simplification appears to be satisfactory, this is certainly not the case for coffee and agriculture where the predicted output elasticities are well overestimated. This result is to be explained by the fact that

agriculture, the largest traded sector, has a low rate of protection and would expand substantially if land were not a constraint. The resource pull on that factor raises its rate of return by 14% when it is mobile. If this effect were captured in equation 2, the resulting overestimation for sectors 1 and 2 would be substantially reduced. These results indicate the importance of correctly estimating factor price changes and tariff or tax changes when there are quotas in specified sectors.

V. Conclusion

Even within a simple general equilibrium model, it is the interaction of many effects which ultimately determines the impact of price distortions on resource allocation. Implementation of the model outlined here suggests that some effects are likely to be empirically more important than others. Among the more important effects likely to escape intuition, it was found that factor price variations and perhaps more importantly, adjustments in the relative price of non-traded goods in response to tariff changes, are likely to have a bearing on sectoral output responses to changes in tariff structures. The results indicate that ERPs provide a good qualitative index of resource pulls. However, the importance of adjustments in factor prices and non-traded goods is revealed when one attempts to predict output response to tariff changes on the basis of ERPs and output elasticities; partial equilibrium estimates are no longer close to those provided by the general equilibrium model.

Above all multi-sector models are an effort at consistently organizing one's information. The model developed in this paper may be best viewed as a useful tool in exploring the relative importance of various interdependencies which should be taken into account when formulating a protective policy. The model indicates that Colombia has the greatest comparative advantage in primary products: agricultural products and mining. Next within the manufacturing sector, it has a comparative advantage in food, beverages and tobacco and in non-metallic products. On average, these sectors are relatively intensive in their use of unskilled labor. One can therefore conclude that a move towards freer trade by providing greater uniformity of incentives between agricultural and manufacturing sectors would increase employment of unskilled labor.

APPENDIX

To facilitate exposition, the following notation is adopted throughout: Greek letters and lower case Roman letters refer to exogenous parameters whose values are given to the model; upper case Roman letters refer to endogenous variables, but upper case Roman letters with a bar are used for exogenous variables. There are $n=q_1 + q_2$ goods produced in the economy; q_1 of these goods are traded; the remainder q_2 are classified as non-traded; Non-competitive imports are lumped into a sector, o. Superscripts are used to distinguish between the initial distorted situation (zero) and any other situation (one). In the case of a single representative consumer considered here,and under the proper assumptions of separability in the production and utility functions maintained in any empirical estimates, Arrow and Hahn (1971) have proved the existence and uniqueness of the solution to the system of equations described in the summary table. Indeed experiments taking widely different starting guesses always converged to the same solution.

The following table gives the rank correlation between different measures of protection and actual output responses under alternative assumptions concerning factor mobility.

TABLE A1

RANK CORRELATION OF MEASURES OF PROTECTION

	Nominal Tariffs	Effective Tariff	General Equilibrium Value-added
Capital Stocks Fixed	.764	.800	.950
Capital Stocks mobile	.845	.864	.955

MODEL SUMMARY

		Number of Equations
	Production Functions	
(1)	$X_i = A_i \prod_\lambda R_{\lambda i}^{\alpha_{\lambda i}}$; $i = 1 \ldots n$, $\lambda = 1 \ldots s$	n
	where: $V_i = \sum_\lambda \alpha_{\lambda i}$	
	Factor Demand Equations	
(2)	$P_i^* \frac{\partial X}{\partial R_{\lambda i}} = W_\lambda$	n·s
	Factor Differential Equations	
(3)	$W_{\lambda i} = d_{\lambda i} \hat{W}_\lambda$	s
	Trading Price Equations	
(4)	$P_o = \pi_o (1 + t_o)$	1
	$P_k = \pi_k (1 + t_k)$	q_1
	Net Price Equations:	
(5)	$P_i^* = P_i - \sum_j a_{ji} P_j - a_{oi} P_o$	n
	Price Normalization Equation:	
(6)	$\sum_i P_i^{*1} X_i^o = \sum_i P_i^{*o} X_i^o$	1
	Consumption Equations:	
(7)	$C_i P_i = P_i \delta_i + \gamma_i (Y - \sum_j P_j \delta_j)$	n-1
	where $Y = \sum_i C_i P_i$	
	Resource Constraints:	
(8)	$\sum_i R_{\lambda i} = \bar{R}_\lambda$	s
	Flow Balance Equations	
(9)	$X_i - T_i - \sum_i a_{ji} X_i - a_{oi} X_i = C_i + Z_i$; $T_i = o$ for $i > q_1$	n
(10)	$\sum_k \pi_k T_k - \pi_o \sum_i a_{oi} X_i = \Delta$; $k = 1 \ldots q_1$	1

LIST OF VARIABLES AND PARAMETERS

X_i, C_i, $\bar{Z}_i$	Gross output, private consumption and exogenous demand (Government demand + investment demand + depreciation) in sector i.
$R_{\lambda i}$	Use of primary factor λ. Estimates of sectoral capital stocks are from Berry (1974)
$\hat{W}_\lambda$	Average wage of primary factor λ .
P_i, P_i^*	Domestic and net price (inclusive of tariffs and subsidies) of sector i.
T_k	Quantity traded (competitively) of sector k (> o for exports)
$\bar{T}_1$	fixed by quota export coffee tax.
$\alpha_{\lambda i}$	The exponent for factor λ in sector i . The exponent for capital, α_{ki}, is derived residually, i.e., $\alpha_{ki} = V_i - \sum_{\lambda \neq k} \alpha_{\lambda i}$
V_i	Returns to scale in sector i : $V_{1\ldots k} = .9\, V_{k+1\ldots n} = 1$
a_{ij}, a_{oi}	Physical input-output coefficient and non-competitive import coefficient of sector i.
$\bar{A}_i$	Normalizing constant (shift parameter) defining units of measurement for sector i; calculated from eq. 1 using base year values.
Δ	Trade gap measured at world prices.
γ_i, δ_i	Marginal expenditure share and subsistence minimum for sector i. These were obtained from Howe (1974).
$d_{\lambda i}$	Differential wage scale parameter for primary factor R_λ. These parameters are the weights defining the average wage $\hat{W}$ in the base period so that $\sum_i d_{\lambda i}(R_{\lambda i}/\bar{R}_\lambda) = 1$
Y	Total private expenditures.
Π_k	World price of commodities produced by sector k; $k=1\ldots q_1$
t_k	Ad valorem tariff (subsidy) for sector K. These were obtained from Hutcheson (1973).

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